



Biological Assessment Report

Finley Creek AES-Type Study Barry, Christian, Douglas, Stone, and Webster Counties

2019 - 2021

Prepared for:

**Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program
Water Pollution Control Branch**

Prepared by:

**Missouri Department of Natural Resources
Division of Environmental Quality
Environmental Services Program
Water Quality Monitoring Section**

TABLE OF CONTENTS

	Page
1.0 Introduction.....	1
1.1 Study Area/Justification.....	1
1.2 Purpose.....	1
2.0 Objectives	1
2.1 Null Hypotheses.....	3
3.0 Study Area	3
3.1 MoRAP Aquatic Ecological Classification	3
3.1.1 Ecological Drainage Unit.....	3
3.1.2 Aquatic Ecological Systems	3
3.1.3 Valley Segment Types	3
3.2 Station Descriptions.....	4
3.2.1 Finley Creek AES-Type Study Sampling Stations	4
3.2.2 Biological Criteria Reference Stream Sampling Stations	4
4.0 Methods.....	7
4.1 Land Cover.....	7
4.2 Habitat Assessment.....	7
4.3 Biological Assessment.....	7
4.3.1 Macroinvertebrate Collection and Analysis.....	7
4.4 Physicochemical Collection and Analysis	8
4.4.1 <i>In situ</i> Water Quality Measurements	8
4.4.2 Water Chemistry	8
4.4.3 Data Analysis.....	8
4.5 Quality Assurance/Quality Control (QA/QC)	8
4.5.1 Field Meters	8
4.5.2 Biological Samples	9
4.5.3 Biological Data Entry	9
4.5.4 Duplicate Sample Collection	9
5.0 Results.....	9
5.1 Land Cover.....	9
5.2 Stream Habitat Assessment.....	9
5.3 Macroinvertebrate Biological Assessment	12
5.3.1 Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP)	12
5.3.2 Macroinvertebrate Percent and Community Composition	14
5.3.2.1 Fall 2019 Sampling Season.....	14
5.3.2.2 Spring 2021 Sampling Season	22
5.4 Physicochemical Water Data	29
5.5 Quality Assurance/Quality Control (QA/QC)	32
5.5.1 Duplicate Samples	32

	Page
6.0 Discussion.....	32
6.1 Land Cover.....	32
6.2 Stream Habitat	33
6.3 MSCI and Biological Metrics	33
6.4 Macroinvertebrate Community Composition	34
6.5 Physicochemical Water Parameters	34
7.0 Conclusions.....	35
8.0 References Cited	36

TABLES

Table 1	Physical Characteristics of the Sampling Reaches for the Finley Creek AES Type Study Based on Values from the MoRAP Valley Segment Types (VST) Geographic Information Systems (GIS) Layer and Other GIS Sources	5
Table 2	Percent Land Cover (2019 NLCD)	10
Table 3	Predominant Category Habitat Values, Category Habitat Scores, Total Habitat Scores, and Percent of Reference SHAPP Values from Stream Habitat Assessments for the Finley Creek AES-Type Study Stream Stations and the BIOREF Stream Stations	11
Table 4	Fall 2019 Riffle/Pool Ozark/White EDU Stream Biological Criteria, Biological Support Categories, Biological Metric Values and Scores shown in Parentheses, and Macroinvertebrate Stream Condition Index (MSCI) Scores for the Finley Creek AES-Type Stream Stations and BIOREF Sampling Stations	13
Table 5	Spring 2021 Riffle/Pool Ozark/White EDU Stream Biological Criteria, Biological Support Categories, Biological Metric Values and Scores shown in Parentheses, and Macroinvertebrate Stream Condition Index (MSCI) Scores for the Finley Creek AES-Type Stream Stations and BIOREF Sampling Stations.....	14
Table 6	Percent Dominant Family at the Finley Creek AES-Type Study Stream Stations, BIOREF stream stations, and the Ozark/White EDU Biological Criteria Reference Samples, Fall 2019	20
Table 7	Percent Dominant Taxa at the Finley Creek AES-Type Study Stream Stations, BIOREF stream stations, and the Ozark/White EDU Biological Criteria Reference Samples, Fall 2019	21

	Page
Table 8	Percent EPTT and Dominant Macroinvertebrate Families at the Finley Creek AES-Type Study Stream Stations, BIOREF stream stations, and the Ozark/White EDU Biological Criteria Reference Samples, Spring 202127
Table 9	Percent Dominant Taxa at the Finley Creek AES-Type Study Stream Stations, BIOREF stream stations, and the Ozark/White EDU Biological Criteria Reference Samples, Spring 202128
Table 10	Physicochemical Variables for Surface Water Samples at the Finley Creek AES-Type Study Sampling Stations, Fall 2019.....30
Table 11	Physicochemical Variables for Surface Water Samples at the Finley Creek AES-Type Study Sampling Stations, Spring 202131

FIGURES

Figure 1	Map of the Finley Creek AES-Type2
Figure 2	AES-Types and Sampling Locations in the Ozark/White EDU6
Figure 3	Percent of Taxa by Biotic Index Range, Fall 2019.....16
Figure 4	Percent of Taxa by Functional Feeding Group, Fall 2019.....17
Figure 5	Scraper/Filterer Ratio, Fall 2019.....18
Figure 6	Percent of Taxa by Biotic Index Range, Spring 202123
Figure 7	Percent of Taxa by Functional Feeding Group, Spring 202124
Figure 8	Scraper/Filterer Ratio, Spring 202125

ATTACHMENTS

Appendix A	Macroinvertebrate Bench Sheets for the Finley Creek AES-Type Study
------------	--

1.0 Introduction

At the request of the Missouri Department of Natural Resources (**MoDNR**) Water Protection Program (**WPP**), the Environmental Services Program (**ESP**) Water Quality Monitoring Section (**WQMS**) conducted biological assessments on seven streams located within the Finley Creek Aquatic Ecological System (**AES**) Type (Sowa and Diamond 2006) in the Ozark/White Ecological Drainage Unit (**EDU**). For comparison of these stream reaches, all warm water biological criteria reference (**BIOREF**) streams for the Ozark/White EDU were also sampled for this study. Sampling for this bioassessment project occurred during the fall 2019 and spring 2021 sampling seasons. Sampling was originally planned to occur during fall 2019 and spring 2020, but the spring sampling was postponed until spring 2021 because of travel restrictions enacted by MoDNR leadership personnel in March of 2020 in response to the global COVID-19 pandemic.

1.1 Study Area/Justification

The Finley Creek AES-Type is located in southwest Missouri in parts of the Ozark/Neosho, Ozark/Osage, and Ozark/White EDUs (Figure 1). Within the Ozark/White EDU, the Finley Creek AES-Type contains the James River and its tributaries. Except for a few streams in the Springfield metropolitan area, MoDNR has conducted very few biological assessments of Finley Creek AES-Type streams within the Ozark/White EDU. Because of this, little information is available about the ecological health and taxonomic diversity of these streams.

Streams that were determined to be the best available and least impaired in the Finley Creek AES-Type were selected for this study. Streams were selected using geographic information system (GIS) datasets including a GIS model developed by the University of Missouri that predicts the highest quality streams for creeks and small rivers (Kleekamp 2016).

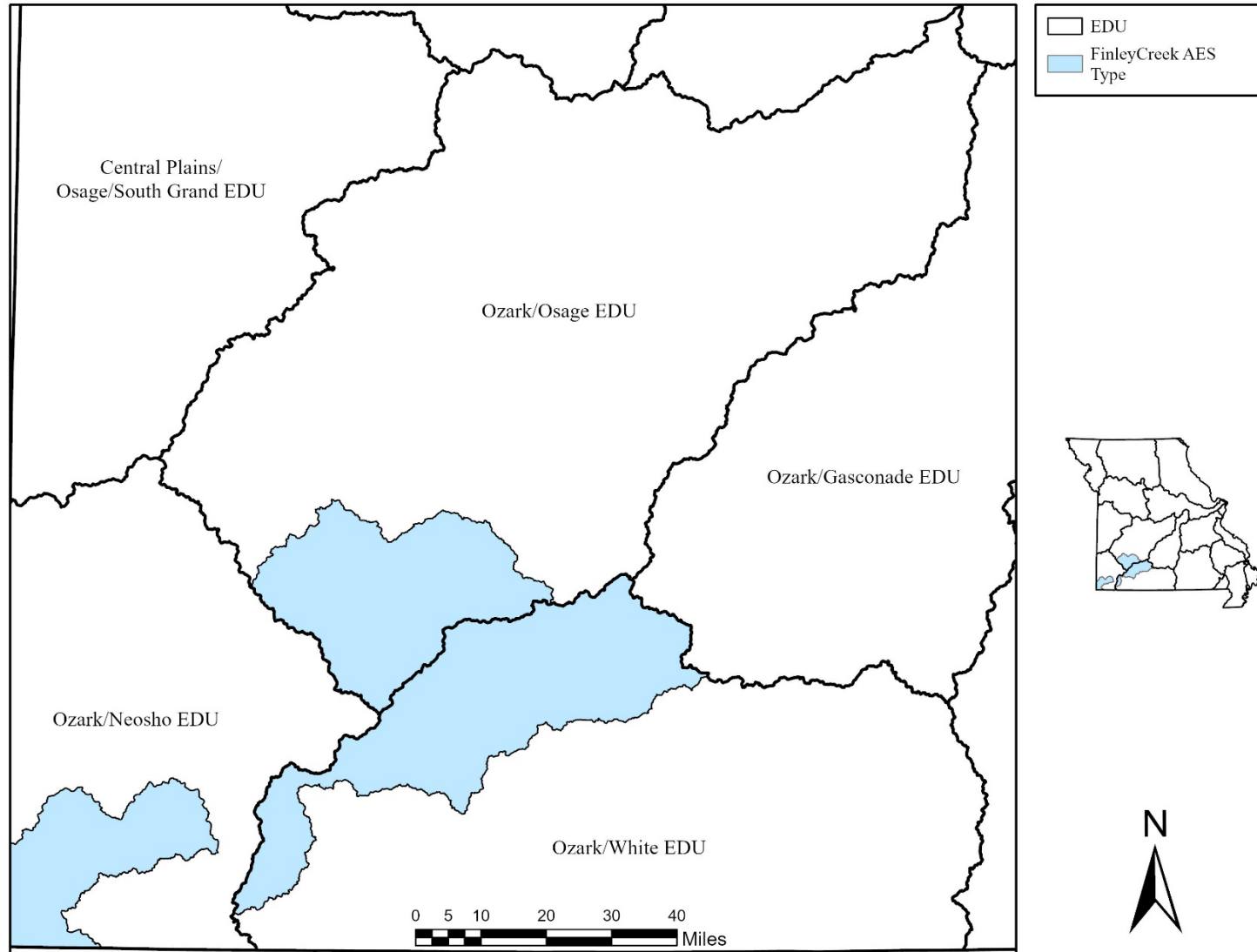
1.2 Purpose

The purpose of this study is to assess the biological integrity of Finley Creek AES-Type streams and determine if they are capable of attaining fully supporting status when evaluated using Ozark/White EDU wadeable/perennial biological criteria.

2.0 Objectives

The objectives of this study were to evaluate stream habitat quality, water chemistry, and the macroinvertebrate community to determine if Finley Creek AES-Type study streams support aquatic life and meet water quality standards. The macroinvertebrate community and the instream habitat of the study streams were compared to samples collected at Ozark/White EDU BIORREF streams and to the Ozark/White EDU biological criteria. Water quality and nutrient parameters were compared among the Finley Creek AES-Type study stations, Missouri's Water Quality Standards (**WQS**) (MoDNR 2018e), and EPA's ambient water quality criteria recommendations for nutrients (USEPA 2000).

Figure 1. Map of the Finley Creek AES-Type.



2.1 Null Hypotheses

- 1) The macroinvertebrate assemblage of Finley Creek AES-Type study streams will be similar to the macroinvertebrate community of BIOREF streams in the Ozark/White EDU.
- 2) Physicochemical water quality from the Finley Creek AES-Type study streams will meet the WQS of Missouri (MoDNR 2018e).
- 3) Stream habitat at sampling stations for the Finley Creek AES-Type study streams will be similar to the BIOREF streams in the Ozark/White EDU.

3.0 Study Area

3.1 MoRAP Aquatic Ecological Classification

The aquatic ecological classification developed by the Missouri Resource Assessment Partnership (**MoRAP**) is a classification system that divides the aquatic resources of Missouri into distinct regions. It has seven levels of classification starting at large regions and then dividing them into smaller sub-regions (Sowa et al. 2004). The following are the seven levels of classification in hierarchical order: zone, subzone, region, aquatic sub-regions, EDU, AES, and Valley Segment Types (**VST**). The levels of classification are based on biology, zoogeography, taxonomic composition, geology, soils, and groundwater connection. Some levels of the hierarchical system use geology and soils to classify, whereas other levels use biology and taxonomic composition of aquatic communities. EDU, AES, and VST are the three levels of classification that will be discussed in detail for this study.

3.1.1 Ecological Drainage Unit

The EDU is level five of the classification hierarchy and is based on geographical variation of the taxonomic composition of the level four sub-regions. An EDU is a region in which aquatic biological communities and habitat conditions can be expected to be similar. All of the Finley Creek AES-Type study sample stations were located within the Ozark/White EDU.

3.1.2 Aquatic Ecological Systems

Aquatic Ecological Systems are level six of the classification hierarchy. They classify aquatic systems based on geology, soils, landform, and groundwater influence. All of the study streams are located in the Finley Creek AES-Type (Sowa and Diamond 2006). Local relief for the Finley Creek AES-Type is variable and ranges from nearly zero to 200 feet. Bedrock geology is dominated by Mississippian period cherty limestones with significant karst features like sinkholes, caves, and springs. Sinkholes and losing streams are very abundant, with some of the highest densities occurring in this AES-Type. Surface soil textures consist of cherty and silt loams with moderate to slow infiltration rates. Streams carry bed loads consisting of sand and chert gravel with very little suspended sediment. Springs are common and can be quite large, contributing significantly to stream base flows.

3.1.3 Valley Segment Types

Valley Segment Types are level seven of the classification hierarchy. Stream segments in the GIS stream network layer are classified using a 5-digit code. The 5-digit VST code is based on

temperature regime, stream size, flow regime, geology, and relative gradient. The 5-digit VST codes and values for the five parameters making up the codes can be found in Table 1.

3.2 Station Descriptions

The study area and sampling locations for the Finley Creek AES-Type study are shown in Figure 2.

3.2.1 Finley Creek AES-Type Study Sampling Stations

James River 2365_26.7 – Webster County, downstream of Bell Ford Road. Legal description is NE 1/4 Sec. 04, T. 29 N., R. 18 W. Geographic coordinates are UTM zone 15, 507969 Easting, 4123765 Northing.

Finley Creek 2352_36.6 – Webster County, upstream of Olga Road. Legal description is SE 1/4 Sec. 30, T. 28 N., R. 18 W. Geographic coordinates are UTM zone 15, 504976 Easting, 4105024 Northing.

Little Finley Creek 2356_1.3 – Webster County, downstream of Country View Road. Legal description is SE 1/4 Sec. 14, T. 28 N., R. 18 W. Geographic coordinates are UTM zone 15, 511921 Easting, 4107818 Northing.

Crane Creek 2381_4.0 – Stone County, located next to Bluff Road. Legal Description is SW 1/4 Sec. 9, T. 25 N., R. 23 W. Geographic coordinates are UTM zone 15, 458870 Easting, 4081635.

Dry Crane Creek 2381_3.2_0.6 – Stone County, located next to Long Hollow Road. Legal Description is SE 1/4 Sec. 9, T. 25 N., R. 23 W. Geographic coordinates are UTM zone 15, 459140 Easting, 4082050.

Flat Creek 2387_36.2 – Barry County, downstream of Farm Road 1142. Legal Description is SE 1/4 Sec. 23, T. 24 N., R. 27 W. Geographic coordinates are UTM zone 15, 427550 Easting, 4070197.

Calton Creek 2392_2.9 – Barry County, upstream of Farm Road 1140. Legal Description is SW 1/4 Sec. 17, T. 25 N., R. 26 W. Geographic coordinates are UTM zone 15, 427717 Easting, 4080927.

3.2.2 Biological Criteria Reference Stream Sampling Stations

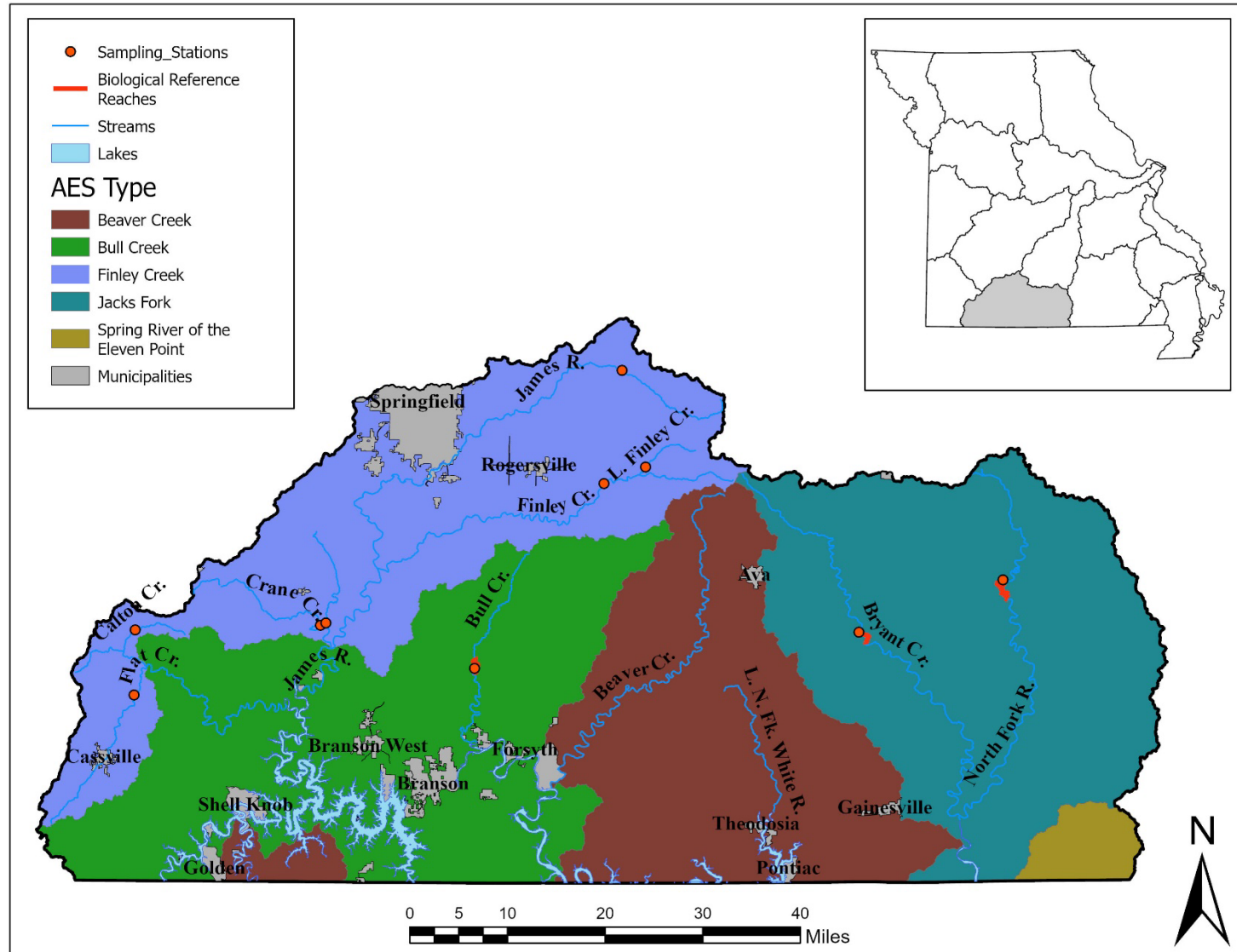
North Fork of the White River 2507_19.7 – Douglas County, located about 0.2 miles downstream of County Road E-276. Legal Description is SE 1/4, Sec. 12, T. 26 N., R. 12 W. Geographic coordinates are UTM zone 15, 570810 Easting, 4089190.

Bryant Creek 2535_23.3 – Douglas County, located downstream of Rippee Creek at the Missouri Department of Conservation's Rippee Conservation Area. Legal Description is NW 1/4 Sec. 10, T. 25 N., R. 14 W. Geographic coordinates are UTM zone 15, 547082 Easting, 4080534.

Table 1. Physical Characteristics of the Sampling Reaches for Study Stream Reaches for the Finley Creek AES-Type Study Based on Values from the MoRAP Valley Segment Types (VST) Geographic Information Systems (GIS) Layer and Other GIS Sources

	James River #26.7	Finley Creek #36.6	L. Finley Creek #1.3	Crane Creek #4.0	Dry Crane Creek #0.6	Calton Creek #2.9	Flat Creek #36.2	Bull Creek #10.1	NF White River #19.7	Bryant Creek #23.3
Watershed Area (mi ²)	53.3	76.7	11.5	131.3	20.4	11.8	88	104.4	72	191
Strahler Order	4	4	3	5	3	3	4	5	5	5
Link Magnitude	51	71	13	96	12	13	74	97	62	175
VST 5 Digit Code	22121	23123	22123	23123	22123	22123	23122	23123	23143	23122
Temperature Regime	Warm	Warm	Warm	Warm	Warm	Warm	Warm	Warm	Warm	Warm
Stream Size	Creek	Small River	Creek	Small River	Creek	Creek	Small River	Small River	Small River	Small River
Flow Regime	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Geology	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Sandstone	Limestone
Relative Gradient	Low	High	High	High	High	High	Medium	High	High	Medium

Figure 2. AES-Types and Sampling Locations in the Ozark/White EDU



Bull Creek 2423_10.1 – Christian County, located near Dry Hollow Road. Legal Description is SE 1/4 Sec.36, T. 25 N., R. 21 W. Geographic coordinates are UTM zone 15, 483666 Easting, 4074536.

4.0 Methods

Macroinvertebrate and water quality samples were collected during fall 2019 and spring 2021 by WQMS's Aquatic Bioassessment Unit. Spring samples were originally scheduled to be collected in 2020 but were postponed because of travel restrictions enacted by MoDNR leadership personnel in March of 2020 in response to the global COVID-19 pandemic. Methods for stream habitat assessments, biological assessments, and physicochemical water quality are included in this section. All samples were handled according to the appropriate MoDNR ESP Standard Operating Procedures (SOP) or Project Procedures (PP).

Macroinvertebrates, water quality sample collections, and stream habitat assessments took place in the fall 2019 sampling season from September 17 to October 10, 2019. Spring 2021 macroinvertebrate and water quality samples were collected March 10 to April 14, 2021.

4.1 Land Cover

Land cover percentages were determined using the 2019 National Land Cover Database (United States Geological Survey [USGS] 2019) and calculated using the hydrology toolbox in ArcGIS® 10.7.1 software by Esri ArcGIS®. Land cover percentages were determined for the entire Ozark/White EDU, Finley Creek AES-Type study sampling stations, and the BIOREF sampling stations in the Ozark/White EDU (Table 2).

4.2 Habitat Assessment

A standardized assessment procedure was followed as described for riffle/pool habitat in the *Stream Habitat Assessment Project Procedure (SHAPP)* (MoDNR 2019e). Habitat assessments were conducted at the Finley Creek AES-Type study stations and the three BIOREF stations in the Ozark/White EDU.

4.3 Biological Assessment

Biological assessments consisted of macroinvertebrate collection and physicochemical sampling for the two sample periods.

4.3.1 Macroinvertebrate Collection and Analysis

A standardized macroinvertebrate sample collection and analysis procedure was followed as described in the *Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP)* (MoDNR 2019a) for riffle/pool (RP) streams. Three standard habitats were sampled: flowing water over coarse substrate (CS), depositional substrate in non-flowing water (NF), and rootmat (RM).

Macroinvertebrate data were analyzed using two methods. The first analysis was to calculate the Macroinvertebrate Stream Condition Index (MSCI) using the four general biological metrics found in the SMSBPP (MoDNR 2002, MoDNR 2019a). These four biological metrics were: 1) Taxa Richness (TR), 2) Ephemeroptera/Plecoptera/Trichoptera Taxa (EPTT), 3) Biotic Index

(**BI**), and 4) Shannon Diversity Index (**SDI**). These individual metrics were scored by comparing them to the biological criteria for perennial/wadeable streams in the Ozark/White EDU and combining to form the MSCI. MSCI scores of 16-20 qualify as fully supporting, 10-14 are partially supporting, and 4-8 are considered non-supporting of the protection of warm water habitat beneficial use designation as specified in the Missouri WQS (MoDNR 2018e).

The second analysis was an evaluation of macroinvertebrate community composition using percent composition of EPTT, sensitive taxa, functional feeding groups (**FFG**), and dominant macroinvertebrate families and taxa. The macroinvertebrate communities of Finley Creek AES-Type study stations and the BIOREF streams also were compared.

4.4 Physicochemical Data Collection and Analysis

4.4.1 *In situ* Water Quality Measurements

During each sampling period, *in situ* water quality measurements were collected at each of the bioassessment sampling stations. Field measurements included water temperature (°C) (MoDNR 2018c), dissolved oxygen (mg/L) (MoDNR 2019b), conductivity (µS/cm) (MoDNR 2018d), and pH (MoDNR 2018b).

4.4.2 Water Chemistry

Surface water grab samples were collected and returned for analyses to ESP. Turbidity (NTU) (MoDNR 2018a) was measured and recorded in the ESP WQMS biology laboratory. Water samples were analyzed by ESP's Chemical Analysis Section for total suspended solids, chloride, sulfate, total calcium, total magnesium, total phosphorus, ammonia-N, nitrate+nitrite-N, hardness, and total nitrogen. Procedures outlined in *Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations* (Standard Operating Procedure [SOP] MDNR-ESP-001 [MoDNR 2020b]) and *Field Sheet and Chain-of-Custody Record* (SOP MDNR-ESP-002 [MoDNR 2021a]) were followed when collecting water quality samples. Stream velocity was measured at each station using a SonTek/YSI Flow Tracker Handheld-ADV (Acoustic Doppler Velocimeter). Discharge was calculated per the methods in SOP MDNR-ESP-113, *Flow Measurement in Open Channels* (MoDNR 2020c).

4.4.3 Data Analysis

Physicochemical data were examined by analyte to determine whether stations had violations of the Missouri WQS. Sampling stations that had values not in compliance with the WQS or U.S. EPA recommended reference values are discussed in the report with possible influences being identified.

4.5 Quality Assurance/Quality Control (QA/QC)

4.5.1 Field Meters

All field meters used to collect water quality parameters were maintained in accordance with the Standard Operating Procedure MDNR-ESP-213, *Quality Control Procedures for Checking Water Quality Field Instruments* (MoDNR 2016).

4.5.2 Biological Samples

Steps to assure accuracy of organism removal from sample debris were performed consistent with those methods found in the SMSBPP (MoDNR 2019a). Macroinvertebrates found in samples were identified to the lowest practicable taxonomic levels found in Standard Operating Procedure MDNR-ESP-209, *Taxonomic Levels for Macroinvertebrate Identification* (MoDNR 2021b).

4.5.3 Biological Data Entry

All macroinvertebrate data were entered into the WQMS macroinvertebrate database consistent with the Standard Operating Procedure MDNR-ESP-214, *Quality Control Procedures for Data Processing* (MoDNR 2019d).

4.5.4 Duplicate Sample Collection

Duplicate samples are used to assess the precision associated with sampling methodology, sample heterogeneity, and analytical procedures (MoDNR 2019c). Duplicate samples are collected at two randomly selected sampling stations per season for macroinvertebrates and for 10 percent of water samples. During the fall 2019 sampling season, duplicate macroinvertebrate and water samples were collected at James River 2365_26.7 and duplicate water samples were collected at Calton Creek 2392_2.9. During the spring 2021 sampling season, duplicate macroinvertebrate and water samples were collected at Flat Creek 2387_36.2.

5.0 Results

5.1 Land Cover

The Finley Creek AES-Type study streams had a substantially higher percentage of hay/pasture and a much lower percentage of forest than the BIOREF streams and the Ozark/White EDU overall (Table 2). With the exception of Finley Creek and Little Finley Creek, the percentage of cropland was slightly higher at study streams than BIOREF streams and the Ozark/White EDU overall. Impervious surface and developed land cover categories (open, low, medium, high) were generally a little higher among test streams than BIOREF streams, but they were similar to the overall Ozark/White EDU. Except Calton Creek, differences in pasture and forest were more pronounced at study streams located in the western part of the EDU than those in the north-central part.

5.2 Stream Habitat Assessment

Table 3 provides habitat assessment scores for the Finley Creek AES-Type study sites and the BIOREF sites. SHAPP guidance states that test stations scoring at least 75 percent of a reference station score should support a similar biological community (MoDNR 2019e). Because stream habitat assessment scores for the study streams all were ≥ 75 percent of the average reference stream scores, they should support a comparable macroinvertebrate community.

Most habitat metric scores at the study stream stations were either in the optimal or suboptimal range, indicating good habitat quality. A few metrics, however, did not score as well. Vegetative protection for both banks was low at all study streams, with scores either in the marginal or poor category. The only other metrics that had lower scores were channel flow status at Little Finley Creek, and riparian zone width at Flat Creek and Calton Creek.

Table 2. Percent Land Cover (2019 NLCD).

Land Cover	Ozark/White EDU	Study Stream Stations							Reference Stream Stations		
		James River 26.7	Finley Creek #36.6	L. Finley Creek #1.3	Crane Creek #4.0	Dry Crane Cr. #0.6	Flat Creek #36.6	Calton Creek #1.9	NF White River #19.7	Bryant Creek #23.3	Bull Creek #10.1
Open Water	1.9	0.1	0.04	0.01	0.02	0.01	0.1	0.04	0.04	0.02	0.05
Average Impervious Surface	2.1	1.6	1.5	1.6	1.4	1.1	2.2	0.8	0.4	0.3	0.9
Impervious Surface ≥10 Percent	5.0	4.1	3.9	4.3	4.2	3.8	5.9	2.8	1.5	1.0	2.6
Developed, Open Space	3.6	3.2	3.8	3.9	3.7	3.7	5.4	2.4	2.7	3.3	1.4
Developed, Low Intensity	2.4	2.1	2.0	2.4	2.4	2.1	2.7	1.8	0.6	0.5	1.4
Developed, Medium Intensity	1.2	0.9	0.8	0.8	0.5	0.3	1.1	0.2	0.1	0.1	0.5
Developed, High Intensity	0.4	0.1	0.1	0.1	0.1	0.03	0.3	0.02	0.01	0.004	0.03
Barren Land	0.2	0.03	0.1	--	0.03	0.03	0.01	0.002	0.1	0.1	0.1
Deciduous Forest	46.6	33.8	39.6	33.6	21.2	21.2	21.5	31.1	54.4	64.1	64.9
Evergreen Forest	4.1	0.1	0.2	0.04	0.2	0.5	0.1	0.002	1.3	0.9	2.8
Mixed Forest	5.5	1.9	1.9	1.7	2.7	2.4	0.6	1.2	4.3	2.8	4.0
Shrub/Scrub	1.2	2.4	1.2	1.1	0.7	0.4	0.9	1.9	1.5	1.8	0.6
Herbaceous	1.0	1.0	1.0	0.7	0.3	0.1	0.3	0.2	0.8	0.6	0.5
Hay/Pasture	31.7	53.0	49.2	55.6	67.7	68.2	66.2	60.1	33.9	25.7	22.1
Cultivated Crops	0.1	1.2	--	--	0.6	1.1	0.9	1.0	0.2	--	--
Wetlands	0.1	0.01	0.02	--	0.1	0.002	0.01	0.01	0.02	0.02	0.05

Table 3. Predominant Category Habitat Values, Category Habitat Scores, Total Habitat Scores, and Percent of Reference SHAPP Values from Stream Habitat Assessments for the Finley Creek AES-Type Study Stream Stations and the BIOREF Stream Stations

Stream Habitat Parameters	Study Stream Stations							Reference Stream Stations		
	James River #26.7	Finley Creek #36.6	L. Finley Creek #1.3	Crane Creek #4.0	Dry Crane Cr. #0.6	Flat Creek #36.6	Calton Creek #1.9	NF White R. #19.7	Bryant Creek #23.3	Bull Creek #10.1
Stream Habitat Assessment Date	09/04/19	09/04/19	09/25/19	09/13/19	09/26/19	10/10/19	09/13/19	09/23/19	09/09/19	09/04/19
Epifaunal Substrate/Available Cover	I (17)	I (20)	I (19)	I (17)	I (18)	I (19)	I (20)	I (16)	I (16)	I (19)
Embeddedness	I (17)	I (17)	I (16)	I (17)	I (16)	I (17)	I (II)	I (17)	I (18)	I (17)
Velocity/Depth Regime	I (18)	I (16)	II (12)	I (20)	II (13)	I (19)	I (16)	I (19)	I (20)	II (15)
Sediment Deposition	II (15)	II (15)	II (14)	II (11)	II (14)	II (14)	II (15)	IV (5)	III (6)	II (15)
Channel Flow Status	II (11)	II (12)	III (8)	I (18)	II (12)	II (14)	II (14)	II (5)	II (14)	III (9)
Channel Alteration	I (20)	I (20)	I (18)	I (20)	I (20)	I (20)	I (20)	I (20)	I (19)	I (20)
Riffle Quality	I (16)	II (15)	II (12)	I (15)	II (12)	I (19)	I (16)	I (17)	II (15)	II (15)
Bank Stability – Left Bank	I (10)	I (9)	I (9)	I (10)	I (10)	II (6)	I (9)	II (6)	I (9)	I (9)
Bank Stability – Right Bank	I (10)	I (10)	I (9)	I (9)	I (10)	I (9)	I (10)	I (10)	I (10)	I (10)
Vegetative Protection – Left Bank	IV (0)	IV (2)	IV (1)	IV (2)	IV (1)	IV (1)	III (4)	IV (1)	IV (1)	IV (2)
Vegetative Protection – Right Bank	III (4)	IV (2)	IV (1)	IV (1)	IV (2)	IV (1)	IV (5)	III (5)	IV (1)	IV (1)
Riparian Zone Width – Left Bank	I (9)	I (10)	I (9)	I (10)	I (9)	IV (2)	I (10)	I (10)	I (10)	I (9)
Riparian Zone Width – Right Bank	I (9)	I (10)	I (9)	II (6)	I (9)	I (9)	III (5)	I (10)	I (9)	I (9)
Total Habitat Score	159	158	137	156	146	150	162	151	148	150
Average Reference Stream Score								149.7		
Percent of Average Reference	106.2	105.5	91.5	104.2	97.5	100.2	108.2	100.9	98.9	100.2

Habitat parameter categories range from I to IV with category I = optimal, category II = suboptimal, category III = marginal, and category IV = poor. Habitat parameter scores are listed in parentheses and range from 0 to 20 except for bank stability, vegetative protection, and riparian zone categories, which range from 0 to 10.

5.3 Macroinvertebrate Biological Assessment

5.3.1 Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP)

Fall 2019 Sampling Season

MSCI scores were calculated for the Finley Creek AES-Type study stream stations and the BIOREF stations using Ozark/White EDU riffle/pool wadeable/perennial biological criteria (Table 4). All study streams except Calton Creek had fully supporting MSCI scores. The Calton Creek SDI value was equal to the fully supporting threshold value for that metric which, along with suboptimal TR and EPTT values, resulted in a partially supporting MSCI score of 14. All of the remaining study stream stations had fully supporting MSCI scores of either 16 or 18. All BIOREF streams had fully supporting scores of 18.

TR values were optimal at all study streams except Calton Creek. For EPTT, values were optimal at the larger streams (James River, Finley Creek, and Crane Creek) and suboptimal among the smaller streams (Little Finley Creek, Dry Crane Creek, and Calton Creek). BI was suboptimal for all study streams except Little Finley Creek and Calton Creek. For SDI, values at the study streams were in the optimal range except at Little Finley Creek and Calton Creek.

Spring 2021 Sampling Season

MSCI scores for the Finley Creek AES-Type study streams and BIOREF streams all were fully supporting, with values ranging from 16 to 20 (Table 5). Streams located in the western part of the EDU had lower fully supporting MSCI scores of 16 except Dry Crane Creek, which had an MSCI score of 18. Study streams in the north-central part of the EDU generally had higher MSCI scores. Little Finley Creek had an MSCI score of 18, and Finley Creek and James River both had scores of 20. MSCI scores at the BIOREF streams were 18 at North Fork of the White River and Bull Creek and 20 at Bryant Creek.

TR values were suboptimal at the study streams, with the exception of James River and Finley Creek, both of which were in fully supporting range. For EPTT, values were optimal at all study streams except Calton Creek, which was in the partially supporting range. BI was optimal for all study streams except Crane Creek and Flat Creek, which were in the partially supporting range. SDI values were optimal at all study streams.

Table 4. Fall 2019 Riffle/Pool Ozark/White EDU Stream Biological Criteria, Biological Support Categories, Biological Metric Values and Scores Shown in Parentheses, and Macroinvertebrate Stream Condition Index (MSCI) Scores for the Finley Creek AES-Type Stream Stations and BIOREF Sampling Stations

Station	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Study Stream Stations							
James River #26.7	19056	95 (5)	29 (5)	5.0 (3)	3.60 (5)	18	F
	19057	81 (5)	29 (5)	5.0 (3)	3.58 (5)	18	F
Finley Creek #36.6	19055	93 (5)	30 (5)	5.1 (3)	3.36 (5)	18	F
L. Finley Creek #1.3	19059	82 (5)	25 (3)	4.8 (5)	3.01 (3)	16	F
Crane Creek #4.0	19060	97 (5)	30 (5)	5.5 (3)	3.54 (5)	18	F
Dry Crane Creek #0.6	19063	81 (5)	20 (3)	6.1 (3)	3.28 (5)	16	F
Flat Creek #36.2	19070	84 (5)	32 (5)	5.3 (3)	3.30 (5)	18	F
Calton Creek #2.9	19061	73 (3)	22 (3)	4.9 (5)	3.17 (3)	14	P
BIOREF Stream Stations							
NF White River #19.7	19058	111 (5)	31 (5)	5.4 (3)	3.84 (5)	18	F
Bryant Creek #23.3	19050	101 (5)	31 (5)	5.0 (3)	3.69 (5)	18	F
Bull Creek #10.1	19062	83 (5)	27 (5)	3.8 (5)	2.81 (3)	18	F
Metric Score=5	If	>79	>25	<5.0	>3.17	20-16	Full
Metric Score=3	If	79-39	25-13	5.0-7.5	3.17-1.59	14-10	Partial
Metric Score=1	If	<39	<13	>7.5	<1.59	8-4	Non

MSCI Scoring Table (in light gray) developed from Ozark/White EDU BIOREF samples ($n = 11$); TR=taxa richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

Table 5. Spring 2021 Riffle/Pool Ozark/White EDU Stream Biological Criteria, Biological Support Categories, Biological Metric Values and Scores shown in Parentheses, and Macroinvertebrate Stream Condition Index (MSCI) Scores for the Finley Creek AES-Type Stream Stations and BIOREF Sampling Stations

Station	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Study Stream Stations							
James River 26.7	21073	100 (5)	38 (5)	4.3 (5)	3.66 (5)	20	F
Finley Creek #36.6	21074	102 (5)	42 (5)	4.3 (5)	3.54 (5)	20	F
L. Finley Creek #1.3	21075	79 (3)	32 (5)	3.4 (5)	3.33 (5)	18	F
Crane Creek #4.0	21063	92 (3)	32 (5)	5.4 (3)	3.42 (5)	16	F
Dry Crane Creek #0.6	21077	93 (3)	38 (5)	3.5 (5)	3.31 (5)	18	F
Flat Creek #36.2	21061	87 (3)	35 (5)	4.9 (3)	3.49 (5)	16	F
	21062	81 (3)	35 (5)	5.1 (3)	3.40 (5)	16	F
Calton Creek #2.9	21078	85 (3)	30 (3)	4.4 (5)	3.30 (5)	16	F
BIOREF Stream Stations							
NF White River #19.7	21081	126 (5)	46 (5)	5.1 (3)	3.87 (5)	18	F
Bryant Creek #23.3	21091	99 (5)	38 (5)	4.5 (5)	3.65 (5)	20	F
Bull Creek #10.1	21079	94 (3)	42 (5)	3.4 (5)	3.34 (5)	18	F
Metric Score=5	If	>95	>31	<4.7	>3.26	20-16	Full
Metric Score=3	If	95-47	31-15	4.7-7.3	3.26-1.63	14-10	Partial
Metric Score=1	If	<47	<15	>7.3	<1.63	8-4	Non

MSCI Scoring Table (in light gray) developed from Ozark/White EDU BIOREF samples ($n = 12$); TR=taxa richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

5.3.2 Macroinvertebrate Percent and Community Composition

The percent composition of sensitive taxa, FFG, EPTT, and the five dominant macroinvertebrate families and taxa at each station are presented in Figures 3 through 5 and Tables 6 and 7. Values in bold type represent the five dominant macroinvertebrate families and taxa for each station.

5.3.2.1 Fall 2019 Sampling Season

Percent Composition of Sensitive Taxa

Most of the Finley Creek AES-Type study and BIOREF streams had a slightly higher percentage of taxa with BI values above 5.0 (higher tolerance to organic pollutants) than the Ozark/White EDU biological criteria data (Figure 3 and Table 7). Taxa with BI values ≥ 5.0 averaged about 48 percent in the Ozark/White EDU biological criteria samples but ranged from about 56 to 74

percent in the Finley Creek AES-Type study and BIOREF streams. The majority of taxa from the study and BIOREF streams had BI values in the moderately tolerant range (BI=5.0-7.4), which was slightly higher than the biological criteria data. Compared to the Ozark/White EDU biological criteria, the percentage for the tolerant taxa range (BI=7.5-8.9) was slightly lower at two of the BIOREF streams (North Fork of the White River and Bryant Creek) and Calton Creek but was higher at Dry Crane Creek. For the remaining sites, the tolerant taxa range was similar or slightly higher than biological criteria. The percentage of very tolerant taxa (BI $\geq$ 9.0) ranged from slightly lower to a little higher in test station samples compared to the biological criteria data, with the lowest value occurring at Calton Creek and the highest at Dry Crane Creek. Taxa with BI <5.0 averaged about 52 percent in the Ozark/White biological criteria samples, but most of the values among test streams and the BIOREF streams were lower and ranged from about 26 to 48 percent. The only exception was at the Bull Creek BIOREF stations in which about 69 percent of the sample was made up of either sensitive (BI=2.5-4.9) or very sensitive taxa (BI<2.5). For most samples, the percentage of sensitive (intolerant) taxa was slightly lower than biological criteria, but North Fork of the White River, Flat Creek, and Calton Creek had similar percentages in this range. Most samples had lower percentages in the very sensitive taxa compared to biological criteria data. The only exceptions were the Bryant Creek sample, which was slightly higher, and one of the James River duplicate samples (#19057), which was similar to Ozark/White biological criteria.

Percent Composition of Functional Feeding Groups (FFG)

Gatherer-collectors and scrapers were the most abundant FFGs in the majority of samples, and filterers were very abundant in others (Figure 4). Gatherer-collectors were present in similar abundance at most stations and were similar to the Ozark/White EDU biological criteria. The only exceptions were the Bull Creek BIOREF station, in which gatherer-collectors were much lower in abundance than reference conditions and Dry Crane Creek, which was much higher. For most samples, percent scrapers ranged from slightly lower to similar to reference conditions. The only exceptions were at Little Finley Creek and the Bull Creek BIOREF station, in which percent scrapers was higher than reference conditions. Filterers made up from about 5 to 26 percent of samples and ranged from much lower to higher compared to reference conditions. Compared to reference conditions, percent filterers was lower at Bull Creek, one of the James River duplicate samples (#19057), and Dry Crane Creek but were much higher at Flat Creek, Calton Creek, and North Fork of the White River. Percent predator values ranged from about 3 to 13 percent and were much lower to a little higher than reference conditions (about 8 percent). For percent shredders, most values were lower than reference conditions; however, Dry Crane Creek, Flat Creek, and Finley Creek percent shredders was slightly higher than references.

For most samples, the percent scraper to filterer ratio was slightly lower to much lower than the Ozark/White EDU reference sites (3.44) and ranged from about 0.68 to 3.15. (Figure 5). The most notable exception was at Bull Creek (13.00), which was considerably higher than reference conditions.

Figure 3. Percent of Taxa by Biotic Index Range, Fall 2019

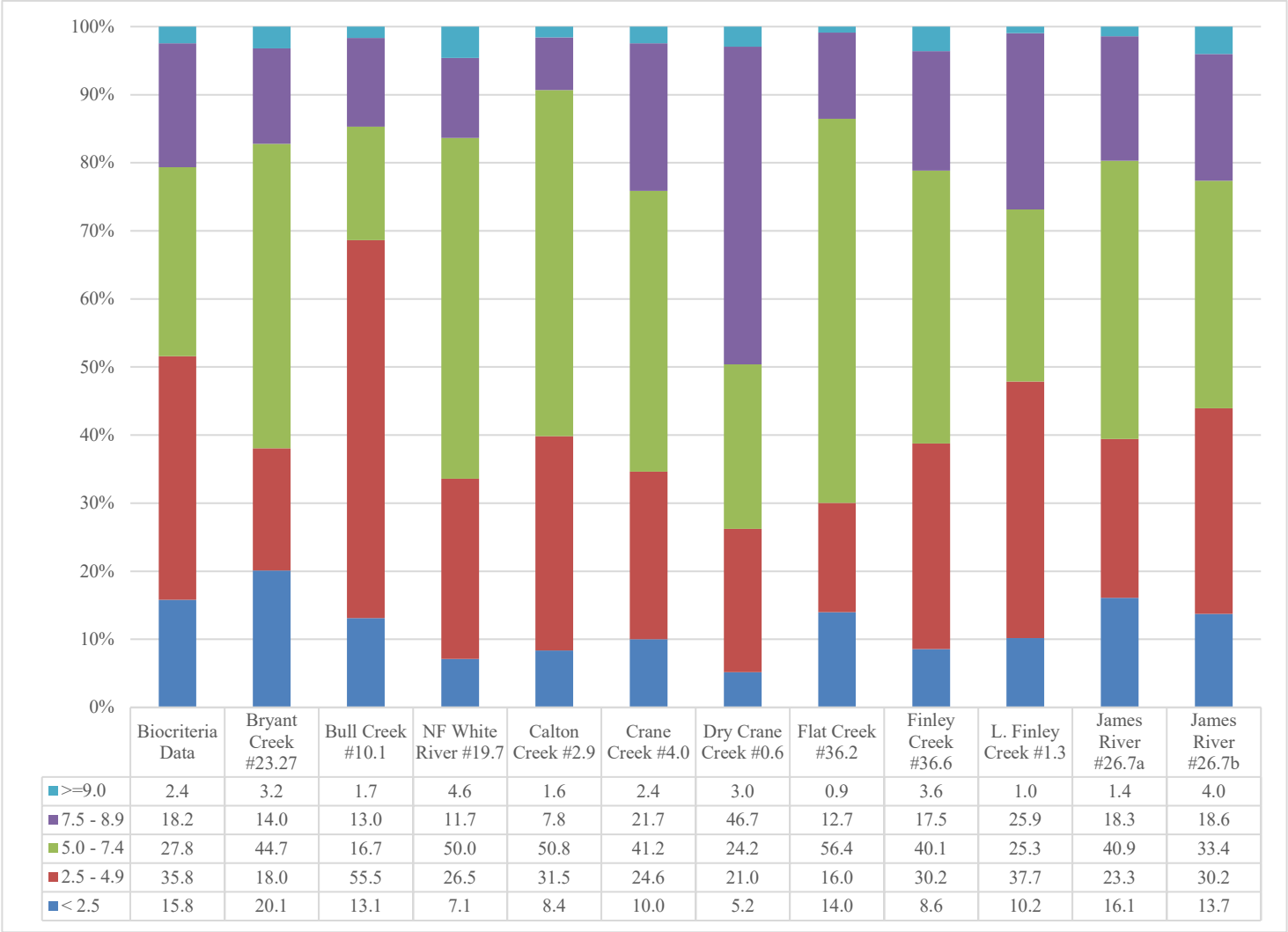
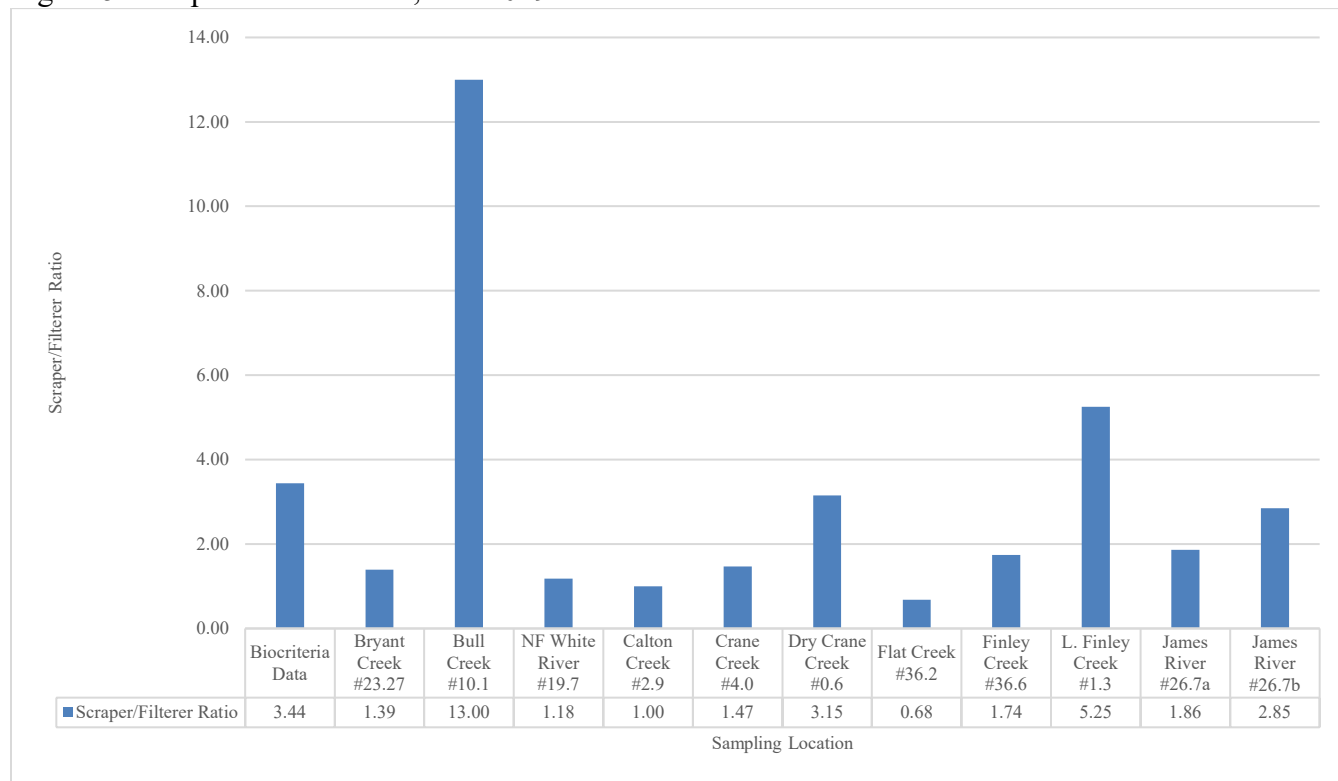


Figure 4. Percent of Taxa by Functional Feeding Group, Fall 2019



*“Other” included piercers, parasites, and taxa that have not been assigned to a FFG

Figure 5. Scraper/Filterer Ratio, Fall 2019



EPT Metrics

Percent EPTT at the Finley Creek AES-Type study stations ranged from slightly lower to much higher compared to the fall 2019 Ozark/White EDU biological criteria data and the BIOREF samples (Table 6). Percent EPTT was lowest at Bull Creek #10.1 and highest at Flat Creek #36.2. Ephemeroptera were abundant in all samples, with percent Ephemeroptera values ranging from slightly lower to a little higher than the Ozark/White EDU biological criteria data. Percent Ephemeroptera values were lowest at Bull Creek and highest at Crane Creek and the James River. With the exception of Crane Creek, percent Plecoptera was much higher in the Finley Creek AES-Type study streams and the Bull Creek sample than the biological criteria data and the other BIOREF stream samples. Percent Trichoptera ranged from slightly lower at Little Finley Creek to much higher at Flat Creek compared to Ozark/White EDU biological criteria data and the BIOREF stream stations. Both Flat Creek and Calton Creek had much higher Trichoptera abundance than the other study and the BIOREF streams.

Macroinvertebrate Community Composition

Chironomids, riffle beetles (Elmidae), and heptageniid mayflies were common in most samples (Tables 6 and 7). Percent Chironomidae ranged from slightly lower to slightly higher than reference conditions. The riffle beetle *Optioservus sandersoni* was more common at North Fork of the White River, Bryant Creek, and Calton Creek, and *Stenelmis* was very common at James River and Flat Creek (Table 7). The riffle beetle *Dubiraphia* was common at the North Fork of the White River and Bryant Creek BIOREF stations but was less abundant at the other sampling stations. The heptageniid mayfly *Stenonema mediopunctatum* was more common at Bryant

Creek, Bull Creek, Crane Creek, and Flat Creek, with values that ranged from similar to higher than reference conditions. *Stenonema pulchellum* was more common at Bull Creek, James River, Little Finley Creek, and Crane Creek. The heptageniid mayfly *S. femoratum* was more abundant at Dry Crane Creek, and *Stenacron* was more common at Crane Creek and Calton Creek than the other sampling stations. The water penny *Psephenus herricki* was common in most samples and were much more abundant than reference conditions at Bull Creek, Finley Creek, and Little Finley Creek. The hydropsychid caddisfly *Cheumatopsyche* was common in most samples and was much more abundant at Crane Creek, Flat Creek, and Calton Creek. The amphipod *Hyaella azteca* was common at most sampling stations and was much more abundant than reference conditions at Bull Creek, Little Finley Creek, Crane Creek, and Dry Crane Creek. Caenid mayflies were common in most samples, ranging from slightly lower to slightly higher than reference conditions. Exceptions were at Bull Creek and Calton Creek, where abundance of caenid mayflies was very low.

Several other taxa were also common in one or more samples. Pleurocerid snails, primarily *Elimia*, were common at North Fork of the White River, Bull Creek, and one of the James River duplicate samples (#19057). The mayfly *Tricorythodes* was abundant at North Fork of the White River and Bryant Creek BIOREF stations, but they were relatively rare or absent at the other stations. The mayfly *Isonychia bicolor* was more abundant than reference conditions at Bryant Creek, James River, and Flat Creek. The baetid mayfly *Baetis* was among the top five abundant taxa at Finley Creek and Flat Creek, and *Dipheter* was abundant only at Calton Creek.

All dominant taxa in the Ozark/White EDU biocriteria fall samples were common in at least some of the sampling stations. All of the dominant taxa except *H. azteca* had BI values either in the very sensitive (BI<2.5) or sensitive range (BI=2.5-4.9). There was more variation in BI values for the Finley Creek AES-Type study streams, with most of the taxa having BI values in the very sensitive, sensitive, or moderately tolerant ranges.

Table 6. Percent Dominant Family at the Finley Creek AES-Type Study Stream Stations, BIOREF stream stations, and the Ozark/White EDU Biological Criteria Reference Samples, Fall 2019

Variable-Station	Ozark/White EDU Criteria Data	Reference Stream Stations			Study Stream Stations							
		NF White River #19.7	Bryant Creek #23.3	Bull Creek #10.1	James River #26.7		Finley Creek #36.6	Little Finley Creek #1.3	Crane Creek #4.0	Dry Crane Creek #0.6	Flat Creek #36.2	Calton Creek #2.9
Sample Number		19058	19050	19062	19056	19057	19055	19059	19060	19063	19070	19061
EPTT Metrics												
%EPTT	39.5	40.5	50.7	26.4	47.5	42.9	41.2	35.2	52.3	37.8	63.2	53.4
%Ephemeroptera	29.4	23.6	36.9	16.3	37.0	34.9	22.8	26.4	36.6	29.7	26.7	23.2
%Plecoptera	0.3	--	0.4	3.1	2.5	2.7	2.4	2.8	0.6	1.1	1.2	1.6
%Trichoptera	9.8	16.9	13.4	7.1	8.0	5.3	15.8	6.0	15.0	6.9	35.3	28.5
Percent Dominant Families												
Chironomidae	13.9	21.8	15.0	7.0	18.4	15.0	15.9	12.7	16.4	16.5	13.0	12.4
Elmidae	12.9	13.2	15.5	5.1	11.9	7.4	4.7	2.2	4.7	6.3	9.1	14.0
Heptageniidae	9.1	2.0	15.4	12.4	2.7	13.7	4.4	12.7	16.8	17.4	10.9	8.1
Psephenidae	8.1	1.3	1.4	36.4	9.8	10.6	18.6	29.6	3.5	8.3	2.0	0.5
Caenidae	6.9	4.9	5.5	0.7	7.4	6.9	3.9	5.0	8.7	6.0	2.4	0.2
Hydropsychidae	3.6	11.9	10.1	3.1	4.6	3.4	9.1	5.2	12.7	2.5	25.9	23.4
Pleuroceridae	6.3	7.0	1.7	11.3	1.3	7.2	3.2	2.2	2.8	0.2	1.2	4.8
Leptohyphidae	1.5	6.6	5.4	--	0.8	0.6	0.6	0.2	0.5	--	0.1	--
Hyalellidae	5.7	3.0	3.6	7.1	2.6	5.6	7.3	11.4	8.2	16.0	2.4	0.7
Isonychiidae	2.8	2.7	5.1	0.8	7.7	5.5	2.0	0.4	2.9	0.2	4.5	--
Baetidae	3.2	5.6	1.4	1.9	4.5	4.9	9.7	3.8	3.9	1.4	6.3	10.0

Biocriteria reference stream data values are average percent ($n = 11$).

Values in bold type represent the five dominant macroinvertebrate taxa for each station

Table 7. Percent Dominant Taxa at the Finley Creek AES-Type Study Stream Stations, BIOREF stream stations, and the Ozark/White EDU Biological Criteria Reference Samples, Fall 2019

Variable-Station	Biotic Index	Ozark/White EDU Criteria Data	Reference Stream Stations			Study Stream Stations							
			NF White River #19.7	Bryant Creek #23.3	Bull Creek #10.1	James River 26.7		Finley Creek #36.6	Little Finley Creek #1.3	Crane Creek #4.0	Dry Crane Creek #0.6	Flat Creek #36.2	Calton Creek #2.9
Sample Number			19058	19050	19062	19056	19057	19055	19059	19060	19063	19070	19061
Percent Dominant Taxa													
<i>Optioservus sandersoni</i>	2.7	9.2	6.2	7.2	0.8	--	--	0.1	--	3.9	5.3	0.7	14.0
<i>Psephenus herricki</i>	2.5	7.6	0.5	0.5	36.0	9.0	10.1	18.0	29.5	3.4	8.3	1.7	0.5
<i>Hyalella azteca</i>	7.9	5.7	3.0	3.6	7.1	2.6	5.6	7.3	11.4	8.2	16.0	2.4	0.7
<i>Elimia</i>	2.5	5.0	3.6	0.7	11.3	1.3	7.2	3.2	2.2	0.5	0.2	1.2	4.8
<i>Stenonema mediopunctatum</i>	1.7	4.0	0.7	9.6	5.5	0.5	0.6	0.1	--	4.4	--	5.5	--
<i>Cheumatopsyche</i>	6.6	2.9	9.1	8.8	3.1	4.6	3.4	8.8	5.2	12.1	2.5	23.9	22.5
<i>Tricorythodes</i>	5.4	1.5	6.6	5.4	--	0.8	0.6	0.6	0.2	0.5	--	0.1	--
<i>Dubiraphia</i>	6.4	2.8	6.0	5.0	1.4	0.5	0.4	1.3	0.2	0.3	0.1	0.3	--
<i>Cladotanytarsus</i>	3.7	1.6	4.9	0.3	--	--	--	0.1	--	--	--	--	--
<i>Isonychia bicolor</i>	2.0	2.8	2.7	5.1	0.8	7.7	5.5	2.0	0.4	2.9	0.2	4.5	--
<i>Stenonema pulchellum</i>	3.0	0.5	0.8	2.2	3.1	2.5	3.7	--	3.7	3.9	1.1	0.7	1.1
<i>Stenelmis</i>	5.4	0.6	0.2	2.8	2.4	11.0	7.1	3.1	1.9	0.5	0.9	8.0	--
<i>Caenis anceps</i>	7.6	2.3	1.0	2.5	0.6	5.3	4.9	3.5	1.0	6.5	0.6	0.1	--
Leptophlebiidae	2.0	1.5	0.7	0.4	0.5	1.9	1.6	0.2	4.2	0.9	3.4	1.8	4.2
<i>Caenis latipennis</i>	7.6	2.3	3.9	3.0	0.1	2.0	2.0	3.5	3.9	2.2	5.4	2.4	0.2
<i>Stenonema femoratum</i>	7.5	1.0	0.4	1.6	2.4	2.0	0.4	2.2	3.9	--	14.3	2.3	0.3
<i>Baetis</i>	6.0	2.6	3.5	0.5	1.7	3.4	3.0	9.3	2.3	3.3	0.8	5.5	3.5
<i>Polypedilum flavum</i>	5.3	0.8	2.3	1.3	0.7	1.7	1.2	5.9	0.7	3.2	0.1	0.9	0.2
<i>Stenacron</i>	7.1	0.2	0.1	0.4	0.5	2.1	2.6	0.6	3.3	6.2	2.1	0.7	5.2
<i>Tanytarsus</i>	6.7	1.8	1.6	1.6	0.2	2.9	1.9	0.6	2.5	1.4	5.4	1.6	0.9
<i>Diphetero</i>	5.0	--	--	--	--	--	--	--	0.3	--	0.3	--	4.7

Biocriteria reference stream data values are average percent ($n = 11$).

Values in bold type represent the five dominant macroinvertebrate taxa for each station

5.3.2.2 Spring 2021 Sampling Season

Percent Composition of Sensitive Taxa

The percentage of taxa with $BI \geq 5.0$ in the Finley Creek AES-Type study and BIOREF streams varied greatly compared to the Ozark/White EDU biological criteria data (Figure 6 and Table 9). Taxa with $BI \geq 5.0$ averaged about 47 percent in the Ozark/White EDU biological criteria samples and ranged from about 34 to 67 percent in the Finley Creek AES-Type study and BIOREF streams. Percentage of samples with $BI \geq 5.0$ were much lower at Bull Creek, Dry Crane Creek, and Little Finley Creek, whereas values at North Fork of the White River, Crane Creek, and Flat Creek were much higher. The majority of samples were made up of taxa with BI values in the moderately tolerant range ($BI = 5.0-7.4$) and were either similar or slightly higher than the biological criteria data. Exceptions were Bull Creek, Dry Crane Creek, Little Finley Creek, and James River, all of which had a higher percentage of taxa either in the sensitive range ($BI = 2.5-4.9$) or very sensitive range ($BI < 2.5$). For most samples, the percentage in the tolerant range ($BI = 7.5-8.9$) were either similar or slightly higher than reference conditions. Exceptions were a slightly lower value at the BIOREF stream Bull Creek and much higher values at Crane Creek, Flat Creek, and James River. Each of the streams sampled had less than 5 percent of taxa in the very tolerant range (≥ 9.0), with values that were roughly similar to Ozark/White EDU reference streams. Sensitive taxa ($BI = 2.5-4.9$) made up about 25 to 40 percent of taxa in samples and ranged from slightly lower to a little higher compared to reference conditions. For very sensitive taxa ($BI < 2.5$), values ranged from much lower (about 9 percent) at Flat Creek 36.2b (a duplicate sample) to much higher (about 39 percent) at Little Finley Creek compared to the Ozark/White EDU criteria.

Percent Composition of Functional Feeding Groups (FFG)

Gatherer-collectors and scrapers were again the most abundant FFGs in the majority of samples (Figure 7). At Calton and Dry Crane creeks, shredders were the most abundant FFG and were also abundant in the remaining samples. Gatherer-collector percentages were either similar to or slightly higher than reference conditions for most samples. The only exceptions were the lower values at Bull and Dry Crane creeks compared to Ozark/White EDU biological criteria. For most samples, percent scrapers were lower than reference conditions. Exceptions were Little Finley Creek and the Bull Creek BIOREF sample, both of which had a higher percentage of scrapers compared to reference conditions. Percent shredders ranged from slightly lower to much higher than Ozark/White EDU criteria, with values being especially high at Calton Creek and Dry Crane Creek. Filterers made up from about 3 to 11 percent of samples and ranged from a little lower to slightly higher than reference conditions. Predators made up about 10 to 23.5 percent of the sample composition, ranging from slightly lower to a little higher than reference conditions.

For most samples, the percent scraper to filterer ratio was much lower than the Ozark/White EDU criteria of 4.35 and ranged from about 1.5 to 2.75. (Figure 8). Exceptions included Bull Creek, Finley Creek, Little Finley Creek, and James River, which ranged from slightly higher at James River (5.33) to much higher at Bull Creek (12.98).

Figure 6. Percent of Taxa by Biotic Index Range, Spring 2021

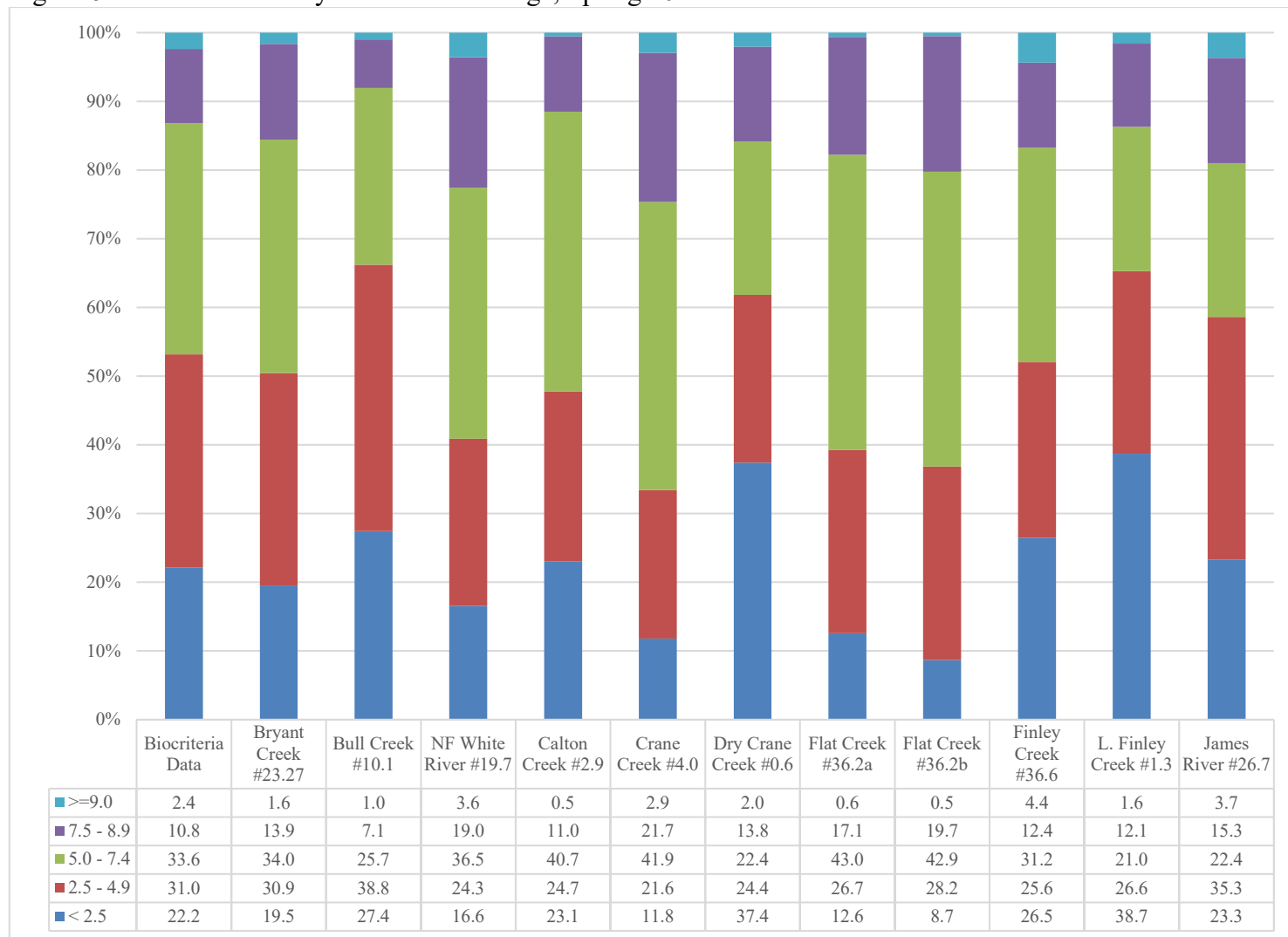
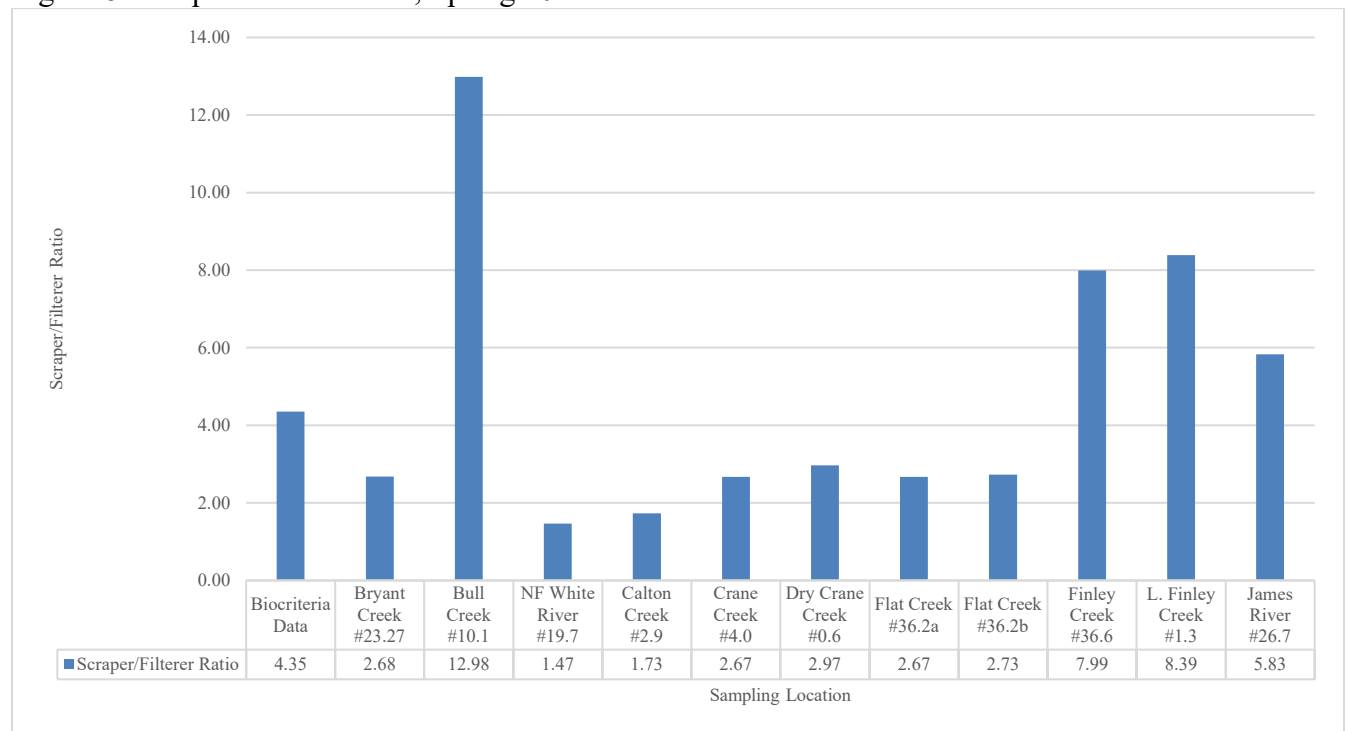


Figure 7. Percent of Taxa by Functional Feeding Group, Spring 2021



*“Other” included piercers, parasites, and taxa that have not been assigned to a FFG

Figure 8. Scraper/Filterer Ratio, Spring 2021



EPT Metrics

For most Finley Creek AES-Type study stations, percent EPTT ranged from slightly lower to much higher compared to spring 2021 Ozark/White EDU biological criteria data and the BIOREF stream samples (Table 8). Exceptions were the much lower percent EPTT values at Crane and Calton creeks. Percent EPTT was lowest at Calton Creek and highest at Little Finley Creek. Except at Calton Creek, mayflies were very abundant in all samples, with percent Ephemeroptera values ranging from much lower at Calton Creek to much higher at Little Finley Creek. Plecoptera were generally very abundant at most stations, with values being much higher than reference conditions. Exceptions were the much lower percent Plecoptera values at Crane and Flat creeks. Percent Trichoptera ranged from slightly lower at Finley and Little Finley creeks to much higher at Flat Creek compared to Ozark/White EDU biological criteria data and most BIOREF stream stations. Percent Trichoptera was much higher at both Flat and Calton creeks than the other study and the BIOREF streams except North Fork of the White River.

Macroinvertebrate Community Composition

Chironomids and heptageniid mayflies were common in all samples, and pleurocerid snails were abundant in most samples (Tables 8 and 9). Other families that were common in at least some samples were ephemereid mayflies, caenid mayflies, and isopods. Percent Chironomidae ranged from much lower at Little Finley Creek to much higher at Calton Creek compared to the Ozark/White EDU criteria samples. Most samples collected in spring 2021 had Chironomidae abundance that was similar to or lower than reference conditions. *Cricotopus/Orthocladius* group and *Eukiefferiella* were the most commonly found chironomids. The heptageniid mayfly *Leucocuta* was abundant in Bull Creek, James River, Finley Creek, and Little Finley Creek but

had low abundance at the other sampling stations. At the remaining stations, other heptageniid mayflies such as *S. mediopunctatum*, *S. pulchellum*, *S. femoratum*, and *Stenacron* were more common. The pleurocerid snail *Elimia* was low in abundance at the BIOREF stations North Fork of the White River and Bryant Creek, but they were very abundant at many of the other stations, including the Bull Creek BIOREF station, Finley Creek, Flat Creek, and Calton Creek. The mayfly *Eurylophella bicolor* was the most common ephemerellid mayfly and was found in most samples. It made up close to 5 percent or greater of samples at Bull, Little Finley, Crane, and Flat creeks. The caenid mayfly *Caenis latipennis* was very abundant at the BIOREF stations North Fork of the White River and Bryant Creek as well as the James River, Finley Creek, Little Finley Creek, and Crane Creek study stations. The isopod *Lirceus* was very abundant in streams located in the western part of the AES-Type (Crane, Dry Crane, Flat, and Calton creeks) but had very low abundances in the other streams.

The stoneflies *Amphinemura*, *Isoperla*, and *Zealeuctra* were abundant in some samples. *Amphinemura* was abundant at the Bull Creek BIOREF station as well as the James River, Little Finley Creek, and Dry Crane Creek study sites. *Isoperla* was common at James River, Finley Creek, and Little Finley Creek. The leuctrid mayfly *Zealeuctra* was very abundant at Calton Creek and Dry Crane Creek, making up roughly 10 and 25 percent of samples, respectively; however, they were absent or present in low abundance at the other sampling stations. Other taxa were common at a few sampling stations such as the riffle beetles *Optioservus sandersoni* and *Stenelmis*, the helicopsychid caddisfly *Helicopsyche*, the hydropsychid caddisfly *Cheumatopsyche*, and the chironomids *Sympotthastia*, *Tanytarsus*, and *Micropsectra*.

Most dominant taxa found in Ozark/White EDU biocriteria spring samples were common in at least some of the sampling stations. One exception was the riffle beetle *O. sandersoni*, which was common only at the Bryant Creek BIOREF station and the Crane Creek and Calton Creek study sites. The other exception was the ephemerellid mayfly *Ephemerella invaria*, which was only common at Crane Creek. With the exception of *Cricotopus/Orthocladius* group, all dominant taxa in Ozark/White EDU biological criteria samples had BI values either in the very sensitive (BI<2.5) or sensitive range (BI=2.5-4.9). There was more variation in BI values for the Finley Creek AES-Type study streams, with most of the taxa having BI values either in the very sensitive, sensitive, or moderately tolerant range (BI=5.0-7.4).

Table 8. Percent EPTT and Dominant Macroinvertebrate Families at the Finley Creek AES-Type Study Stream Stations, BIOREF stream stations, and the Ozark/White EDU Biological Criteria Reference Samples, Spring 2021

		Reference Stream Stations			Study Stream Stations							
Variable-Station	Ozark/White EDU Criteria Data	NF White River #19.7	Bryant Creek #23.3	Bull Creek #10.1	James River #26.7	Finley Creek #36.6	L. Finley Creek #1.3	Crane Creek #4.0	Dry Crane Creek #0.6	Flat Creek #36.2		Calton Creek #2.9
Sample Number		21081	21091	21079	21073	21074	21075	21063	21077	21061	21062	21078
EPTT Metrics												
%EPTT	39.4	54.1	47.5	53.6	59.7	52.3	75.4	35.0	55.9	44.7	40.2	33.0
%Ephemeroptera	30.6	37.0	34.3	34.4	31.9	31.6	46.6	28.8	18.1	28.5	28.7	11.7
%Plecoptera	3.6	7.9	10.0	15.3	24.9	18.2	26.8	1.0	33.8	2.9	2.1	13.3
%Trichoptera	5.2	9.2	3.2	3.9	2.9	2.5	2.0	5.2	4.0	13.3	9.4	8.0
Percent Dominant Families												
Chironomidae	29.8	25.0	28.6	12.4	15.4	24.8	6.5	35.3	17.3	24.3	24.6	41.2
Pleuroceridae	12.4	0.8	0.2	11.5	1.5	7.4	6.2	2.4	7.3	7.8	11.8	8.3
Heptageniidae	11.8	9.6	10.6	20.6	11.9	12.2	23.9	10.8	8.6	9.4	9.7	3.4
Ephemerellidae	9.4	6.6	5.5	7.7	1.6	0.4	5.8	9.3	3.2	8.7	8.9	5.1
Elmidae	5.3	4.5	14.8	2.2	6.3	1.5	1.4	5.7	2.3	2.7	2.7	4.9
Caenidae	4.2	13.8	10.3	2.1	9.7	8.2	4.8	4.1	1.0	3.1	3.6	--
Perlidae	1.7	5.9	5.5	5.7	6.1	4.2	5.3	0.2	1.0	2.5	1.7	1.5
Psephenidae	2.0	0.7	0.5	14.7	3.4	2.3	1.7	0.4	1.3	1.0	0.9	--
Nemouridae	1.0	1.7	2.8	4.5	11.3	3.5	7.8	--	5.8	0.3	0.3	1.0
Perlodidae	1.2	0.3	0.3	3.6	4.0	6.7	7.7	--	1.6	0.1	--	0.1
Baetidae	1.9	3.9	3.9	0.7	3.9	5.3	7.3	0.8	1.8	4.5	3.7	2.4
Asellidae	0.4	0.3	--	0.2	0.4	0.4	0.5	12.4	6.9	10.9	10.4	4.5
Leuctridae	0.9	0.1	1.0	0.5	0.4	0.2	3.6	0.7	24.5	0.1	0.2	10.5
Hydropsychidae	1.3	3.4	1.9	1.2	1.2	0.5	1.0	1.3	0.8	4.3	3.9	5.8

Biocriteria reference stream data values are average percent ($n = 12$).

Values in bold type represent the five dominant macroinvertebrate taxa for each station.

Table 9. Percent Dominant Taxa at the Finley Creek AES-Type Study Stream Stations, BIOREF stream stations, and the Ozark/White EDU Biological Criteria Reference Samples, Spring 2021

Variable-Station	Biotic Index	Ozark/White EDU Criteria Data	Reference Stream Stations			Study Stream Stations							
			NF White River #19.7	Bryant Creek #23.3	Bull Creek #10.1	James River 26.7	Finley Creek #36.6	L. Finley Creek #1.3	Crane Creek #4.0	Dry Crane Creek #0.6	Flat Creek #36.2		Calton Creek #2.9
Sample Number			21081	21091	21079	21073	21074	21075	21063	21077	21061	21062	21078
Percent Dominant Taxa													
<i>Elimia</i>	2.5	12.2	0.6	0.2	11.5	1.5	7.4	6.2	2.3	7.3	7.6	11.8	8.3
<i>Cricoptopus/Orthocladius</i> grp.	6.5	6.7	5.6	7.3	1.6	2.8	3.0	0.3	18.4	3.6	12.8	12.1	11.0
<i>Leucrocuta</i>	0	6.0	--	0.1	11.2	4.5	8.0	14.6	0.5	3.7	--	--	0.1
<i>Ephemerella invaria</i>	2.2	5.4	1.0	1.8	0.1	0.2	0.1	--	3.1	1.5	0.4	0.4	--
<i>Optioservus sandersoni</i>	2.7	3.8	0.8	7.7	0.3	--	0.2	--	5.1	1.0	0.5	0.2	4.9
<i>Caenis latipennis</i>	7.6	2.5	13.8	10.3	2.1	9.5	7.8	4.8	4.1	1.0	3.1	3.6	--
<i>Perlesta</i>	0	1.0	5.9	5.5	3.4	3.0	2.7	4.7	--	--	0.3	0.3	1.4
<i>Eurylophella bicolor</i>	5.1	3.2	4.2	1.6	7.6	1.3	0.4	5.8	4.7	1.6	7.0	6.9	5.1
<i>Eukiefferiella</i>	4.0	1.2	4.0	4.4	1.4	2.2	2.5	0.2	3.3	2.5	2.3	1.3	4.0
<i>Stenelmis</i>	5.4	0.3	0.4	4.6	1.3	6.3	1.2	1.4	0.5	1.2	2.1	2.3	--
<i>Psephenus herricki</i>	2.5	1.8	0.5	0.5	14.7	3.3	2.2	1.7	0.3	1.3	0.8	0.8	--
<i>Amphinemura</i>	3.4	0.9	1.7	2.8	4.5	11.3	3.3	7.7	--	5.7	0.3	0.3	1.0
<i>Isoperla</i>	2.0	1.2	0.3	0.3	3.6	4.0	6.7	7.6	--	1.6	0.1	--	0.1
<i>Sympotthastia</i>	5.7	1.2	0.3	--	0.5	2.0	13.1	1.4	0.1	--	0.5	0.3	0.1
<i>Lirceus</i>	7.7	0.3	0.3	--	--	--	0.4	--	12.4	6.9	10.8	10.4	4.3
<i>Zealeuctra</i>	0	0.5	--	1.0	--	0.4	0.2	--	--	24.5	--	--	10.5
<i>Tanytarsus</i>	6.7	2.3	1.0	1.3	2.3	0.7	0.4	1.7	3.2	3.9	2.2	3.5	3.4
<i>Helicopsyche</i>	0	0.8	0.8	0.2	0.6	0.6	--	--	1.4	0.1	4.3	2.2	0.8
Planariidae	7.5	0.3	0.8	--	0.3	1.2	0.4	1.1	0.6	0.8	2.2	3.8	2.5
<i>Micropsectra</i>	1.4	0.4	0.4	0.7	0.3	--	0.2	0.3	0.5	0.7	0.3	--	8.1
<i>Cheumatopsyche</i>	6.6	1.3	3.3	1.6	1.2	1.2	0.5	1.0	1.2	0.8	3.9	3.6	5.6

Biocriteria reference stream data values are average percent ($n = 12$).

Values in bold type represent the five dominant macroinvertebrate taxa for each station.

5.4 Physicochemical Water Data

Discharge and physicochemical water chemistry results for the BIOREF and Finley Creek AES-Type study stations are presented in Tables 10 and 11. Although there are currently no nutrient criteria in place for Missouri streams and rivers, the nutrient parameters for this study were compared to the U.S. EPA's December 2000 publication *Ambient Water Quality Criteria Recommendations for Rivers and Streams in Nutrient Ecoregion XI* (USEPA 2000). The sampling stations for this study are located within the Ozark Highlands ecoregion, and the recommended values for this ecoregion are: 0.239 mg/L nitrate plus nitrite as N, 0.38 mg/L total nitrogen, 0.007 mg/L total phosphorus, and 1.43 NTU turbidity.

Fall 2019

Stream discharge for the smaller streams (watershed size ≤ 20 square miles) ranged from 0.7 cfs at Little Finley Creek to 3.6 cfs at Calton Creek (Table 10). For the larger streams, discharge ranged from 4.1 and 4.4 cfs (duplicate flow) at James River to 60.1 cfs at Bryant Creek. Analysis of water samples indicated that all sampling stations met Missouri's WQS except dissolved oxygen at James River. Dissolved oxygen measured at 0750 hours at James River was slightly below the 5.0 mg/L minimum standard. All samples exceeded EPA's recommendations for nitrate plus nitrite as N and total nitrogen. Total nitrogen values were much higher for streams located in the western part of the EDU than other study and BIOREF streams. Total phosphorus was above EPA's recommended value at James River, Finley Creek, Dry Crane Creek, and the Bryant Creek BIOREF station. Turbidity values were above EPA's recommended value at the North Fork of the White River BIOREF station, the Bryant Creek BIOREF station, Crane Creek, and Dry Crane Creek.

Spring 2021

Discharge for the smaller streams ranged from 22.4 cfs at Calton Creek to 27.6 cfs at Little Finley Creek. (Table 11). For the larger streams, discharge ranged from about 36 cfs at Flat Creek to 202 cfs at Bull Creek. Analysis of water samples indicated that all sampling stations met Missouri's WQS. All samples exceeded the EPA's recommendations for nitrate plus nitrite as N and total nitrogen. Except Dry Crane Creek, total nitrogen values were much higher for streams located in the western part of the EDU than other study and BIOREF streams. Total phosphorus was above EPA's recommended value at all sampling stations except Finley Creek. Turbidity values were above EPA's recommended value at James River, Finley Creek, Little Finley Creek, Calton Creek, and the North Fork of the White River BIOREF station.

Table 10. Physicochemical Variables for Surface Water Samples at the Finley Creek AES-Type Study Sampling Stations, Fall 2019

	Reference Stream Stations			Study Stream Stations								
	NF White River #19.7	Bryant Creek #23.3	Bull Creek #10.1	James River #26.7		Finley Creek #36.6	L. Finley Creek #1.3	Crane Creek #4.0	Dry Crane Creek #0.6	Flat Creek #36.2	Calton Creek #2.9	
Sample Number	193604	193596	193609	193602	193603	193601	193605	193606	193610	193865	193607	193608
Sample Date	09/23/19	09/17/19	09/26/19	09/19/19	09/19/19	09/18/19	09/25/19	09/25/19	09/26/19	10/10/19	09/25/19	09/25/19
Sample Time	1030	1100	0810	0750	0750	1540	1005	1320	1040	0840	1520	1520
Ammonia	<0.02 ^a	<0.02 ^a	<0.02 ^a	<0.02 ^a	<0.02 ^a	<0.02 ^a	<0.02 ^a	<0.02 ^a	<0.02 ^a	0.02	<0.02 ^a	<0.02 ^a
Chloride	3.02	4.08	6.25	12.0	12.5	10.1	11.9	9.94	6.65	8.61	15.1	14.6
Sulfate	<3.50 ^a	4.67	4.38	7.70	8.27	6.09	7.27	4.27	3.91	4.99	4.43	<3.50 ^a
Total Recoverable Calcium	41.6	47.8	63.3	45.2	43.6	6.2	50.7	70.6	65.5	61.0	71.1	70.7
Total Recoverable Magnesium	25.5	27.5	3.1	13.8	13.5	16.4	18.8	3.86	4.47	2.69	2.42	2.36
Hardness as CaCO ₃	209	233	212	170	164	183	204	192	182	163	188	186
Dissolved Oxygen	8.24	7.62	6.84	4.90	4.89	8.52	7.34	9.49	5.73	7.87	8.61	8.64
Discharge (cfs)	24.4	60.1	30.8	4.1	4.4	5.5	0.7	48.3	1.6	23.6	3.4	3.6
pH (standard units)	7.7	8.1	7.8	7.6	7.6	7.8	7.9	8.2	7.7	7.2	7.9	7.9
Conductivity (µmhos/cm)	383	422	404	356	356	367	407	380	366	328	397	398
Temperature (°C)	19.4	25.1	21.5	23.3	23.3	25.2	20.1	19.8	20.6	17.3	19.6	19.6
Turbidity (NTU)	2.0	3.0	<1.0	1.4	1.2	1.4	<1.0	2.3	2.3	1.1	<1.0	<1.0
Total Suspended Solids	<5 ^a	5	<5 ^a	<5 ^a	<5 ^a	<5 ^a	<5 ^a	<5 ^a	<5 ^a	<5 ^a	<5 ^a	<5 ^a
Nitrate + Nitrite - N	0.82	0.50	0.61	0.35	0.34	0.44	1.20	3.04	1.63	2.87	3.31	3.29
Total Nitrogen	0.78	0.62	0.57	0.37	0.38	0.42	1.20	2.88	1.62	3.76	3.10	3.18
Total Phosphorus	0.007	0.01	<0.005 ^a	0.028	0.024	0.018	<0.005 ^a	<0.005 ^a	0.051	<0.005 ^a	<0.005 ^a	<0.005 ^a

^aBelow detectable limits

Units mg/L unless otherwise noted. Values in bold exceed Missouri WQS or are elevated compared to U.S. EPA recommended reference condition values.

Table 11. Physicochemical Variables for Surface Water Samples at the Finley Creek AES-Type Study Sampling Stations, Spring 2021

	Reference Stream Stations			Study Stream Stations							
	NF White River #19.7	Bryant Creek #23.3	Bull Creek #10.1	James River #26.7	Finley Creek #36.6	L. Finley Creek #1.3	Crane Creek #4.0	Dry Crane Creek #0.6	Flat Creek #36.2		Calton Creek #2.9
Sample Number	21000418	21000389	21000417	21000406	21000408	21000409	21000412	21000415	21000413	21000414	21000416
Sample Date	03/30/21	04/14/21	03/30/21	03/24/21	03/24/21	03/24/21	03/10/21	03/29/21	03/10/21	03/10/21	03/29/21
Sample Time	1330	1545	0905	1025	1315	1510	1440	1330	1135	1135	1535
Ammonia	<0.02 ^a	<0.02 ^a	<0.02 ^a	<0.02 ^a	<0.02 ^a	<0.02 ^a	<0.02 ^a	<0.02 ^a	<0.02 ^a	<0.02 ^a	<0.02 ^a
Chloride	2.81 ^b	2.69 ^b	4.92 ^b	8.73	7.72	10.4	6.80	4.14	7.65	7.81	8.43
Sulfate	4.81 ^b	6.93 ^d	5.68	8.78	5.58	6.60	118 ^{c,d}	5.42	14.8	11.7	4.00 ^b
Total Recoverable Calcium	29.9	44.4	48.5	34.4	34.5	39.8	66.9	51.8	58.9	58.4	46.0
Total Recoverable Magnesium	18.3	25.2	8.46	9.97	11.2	11.3	3.61	3.02	2.48	2.56	1.93
Hardness as CaCO ₃	150	215	156	127	132	146	142	142	157	156	123
Dissolved Oxygen	10.93	11.45	10.48	10.25	11.01	11.28	11.73	11.64	12.60	12.56	13.71
Discharge (cfs)	166	200	202	103	144	27.6	123	25.4	35.9	36.4	22.4
pH (standard units)	8.4	8.6	8.5	8.2	8.2	8.6	8.6	8.2	8.2	8.2	8.46
Conductivity (µmhos/cm)	284	387	316	278	277	301	352	299	323	323	281
Temperature (°C)	12.2	15.6	10.4	11.3	12.1	14.5	13.7	13.4	14.2	14.2	15.6
Turbidity (NTU)	2.11	0.69	1.18	2.21	2.82	1.89	1.27	1.34	1.31	1.10	1.80
Total Suspended Solids	<5 ^a	<5 ^a	<5 ^a	<5 ^a	<5 ^a	<5 ^a	<5 ^a	<5 ^a	<5 ^a	<5 ^a	<5 ^a
Nitrate + Nitrite	0.866	0.291	0.584	1.799	1.19	1.71	3.16^c	1.80^c	3.48^c	3.48	2.87^c
Total Nitrogen	0.79	0.27	0.51	1.79	1.21	1.74	3.12	1.84	3.48	3.47	2.91
Total Phosphorus	0.069	0.014	0.069	0.04	<0.005 ^a	0.11	0.03	0.06	0.07	0.04	0.08^d

^aBelow detectable limits.

^bEstimated value, results between MDL and PQL.

^cSample diluted during analysis.

^dEstimated value, matrix interference.

Units mg/L unless otherwise noted. Values in bold exceed Missouri WQS or are elevated compared to U.S. EPA recommended reference condition values.

5.5 Quality Assurance/Quality Control (QA/QC)

5.5.1 Duplicate Samples

Quantitative Similarity Index for Taxa (QSIT) is a sampling protocol quality control measure that expresses taxa similarity between two samples as a percentage. QSIT was calculated for duplicate samples collected at James River in fall 2019 and Flat Creek in spring 2021. Duplicate samples are expected to have a QSIT of 70 percent or greater (Rabeni et al. 1999). The fall 2019 James River QSIT for duplicate samples was 77.9 percent, and the spring 2021 Flat Creek QSIT was 82.8 percent.

Duplicate water samples were collected at James River and Calton Creek in fall 2019 and at Flat Creek in spring 2021 (Tables 10 and 11). Field measurements and water sample physicochemical analysis results for duplicate samples were similar except the fall 2019 Calton Creek and spring 2021 Flat Creek sulfate results. Both duplicate samples exceeded the 20 percent relative percent difference criterion specified in the Fiscal Year 2020 Quality Assurance Project Plan (MoDNR 2020a).

6.0 Discussion

The discussion section describes possible effects of stream habitat and physicochemical conditions on biological metric scores and the macroinvertebrate community composition.

6.1 Land Cover

Land cover in the Finley Creek AES-Type study stream watersheds had much higher percentages of hay/pasture and much lower percentages of forest than the BIOREF watersheds and the Ozark/White EDU as a whole. Lenat (1984) found that sediment, nutrients, and pesticides increased as agricultural land cover increased, and macroinvertebrate communities tend to respond by having fewer EPTT as well as a higher abundance of certain scrapers, gather-collectors, and filter feeders. The study also found that increased agriculture runoff led to higher periphyton production and particulate organic matter. Higher amounts of periphyton led to higher abundance of certain scrapers like the water penny *P. herricki* and higher abundance of filter feeders like the hydropsychid caddisfly *Cheumatopsyche* during the summer months because of increased particulate organic matter.

Land cover throughout an entire catchment affects stream hydrology and is a strong predictor of total nutrient loading (Boyer et al. 2002). Previous work has found that aquatic biota can start showing negative effects under a wide range of agricultural land cover percentages, with values ranging from 30 to 50 percent in most studies (Meador & Goldstein 2003). A study comparing three streams with distinctly different land cover in the Piedmont region of North Carolina found differences in the macroinvertebrate community (Lenat and Crawford 1994). The study found that a stream in a forested watershed had a much more sensitive macroinvertebrate community with a much higher abundance and diversity of EPTT compared to streams in agricultural and urban watersheds. By contrast, the agricultural stream had a much higher abundance of dipteran taxa, especially chironomids, and the urban stream had a higher abundance of oligochaete worms. Even though a higher percentage of the study stream watersheds have been converted to agricultural uses, biological metric values and MSCI scores indicated that the macroinvertebrate community of most study streams had similar diversity and tolerance values compared to

BIOREF streams. This was somewhat surprising for the streams located on western part of the EDU since total nitrogen concentrations were much higher than the other study streams and the BOREF streams.

Although most Finley Creek AES-Type study streams had diversity and tolerance values similar to reference conditions, there were exceptions. In fall 2019 Calton Creek had lower diversity, and Dry Crane Creek had a higher BI value than optimal criteria thresholds. In spring 2021, Crane and Flat creeks both had suboptimal BI values. There was some evidence, however, that the macroinvertebrate community in these streams located in the western part of the EDU (Calton, Crane, and Flat creeks) had been affected by increased nutrients as evidenced by a higher abundance of the hydropsychid caddisfly *Cheumatopsyche* in these streams during the fall 2019 sampling season.

6.2 Stream Habitat

Instream habitat variables as well as catchment variables have been shown to influence aquatic communities (Wang et al. 2007, Burdon et al. 2013). Stream habitat assessments conducted in fall 2019 indicate that the Finley Creek AES-Type study stations should be comparable to reference conditions in their ability to support a similar quality macroinvertebrate community (Table 3). Although habitat scores were similar to reference conditions overall, vegetative protection for both banks at all study stations and riparian zone width for one bank at Flat Creek and Calton Creek scored in the marginal or poor category. Although vegetative protection was low at all study stations, and riparian zone width was low at two stations, bank stability was good, sedimentation was low, and substrate quality was good.

Intact riparian zones along stream banks are important in maintaining stream health, stream habitat, and healthy water quality (Allan 2004, Waite and Van Metre 2017) by providing leaf litter inputs, shading, and reducing inputs of nutrients and other contaminants from the surrounding landscape (Burrell et al. 2013). A study by Sponseller et al. (2001) found that reduced riparian zone increased algal biomass and changed the algal composition when nutrient levels were sufficient. The reduced riparian zone conditions at Flat Creek and Calton Creek did not lead to higher observable amounts of periphyton growth, despite the reduced shading observed during the fall 2019 sampling season.

6.3 MSCI and Biological Metrics

With the exception of the fall 2019 Calton Creek sample, all macroinvertebrate samples from the Finley Creek AES-Type study and BOREF streams had fully supporting MSCI scores. In fall 2019, Calton Creek attained a partially supporting MSCI score of 14; however, as the SDI value was equal to the metric criteria threshold value, this sample was borderline. BI values were elevated compared to biological criteria in fall 2019 at all stations except Little Finley and Calton creeks. For spring 2021 samples, however, BI values were lower, with the exceptions of Crane Creek and Flat Creek. TR and EPTT values tended to be lower among the smaller streams in fall 2019. There was a trend of lower diversity among the smaller streams in fall 2019, especially for TR and EPTT. This trend was not as pronounced in the spring 2021 sampling season, with the exception of TR at Little Finley Creek.

6.4 Macroinvertebrate Community Composition

The macroinvertebrate community was diverse, and the number of EPTT was generally high, even though most of the Finley Creek AES-Type study streams had a slightly higher percentage of more tolerant taxa than the Ozark/White EDU biological criteria during the fall 2019 sampling season. In contrast, most of the samples collected in spring 2021 had a higher percentage of sensitive taxa. The North Fork of the White River BIOREF station, Crane Creek, and Flat Creek had much more tolerant macroinvertebrate communities during both sampling seasons, and the Bryant Creek BIOREF station and Dry Crane Creek communities were more tolerant during the fall 2019 sampling season than the other sampling stations and the Ozark/White EDU biological criteria. Macroinvertebrate communities were more sensitive at the Bull Creek BIOREF station and Little Finley Creek during both sampling seasons and Dry Crane Creek and James River during the spring 2021 sampling season. For both sampling seasons, sensitive taxa such as *P. herricki* and *Elimia* led to lower overall biotic index values at Bull Creek. Likewise, *P. herricki* helped to reduce the BI value at Little Lindley Creek in fall 2019, and *Leucrocuta*, *Amphinemura*, and *Isoperla* were factors in the spring 2021 sample. Relatively low BI values in the spring 2021 Dry Crane Creek sample were due to *Elimia*, *Amphinemura*, and *Zealeuctra*. For the spring 2021 James River sample, *Leucrocuta*, *Amphinemura*, and *Isoperla* contributed to a low BI value.

Most samples collected in the western part of the Ozark/White EDU had more tolerant macroinvertebrate communities than the other study streams and the BIOREF streams. In these western streams, the filter feeding hydropsychid caddisfly *Cheumatopsyche* was much more abundant during the fall 2019 sampling season, especially at Calton and Flat creeks. For spring 2021 samples, the isopod *Lirceus* was much more abundant in all of the western streams; chironomids were abundant at Calton Creek, and *Cheumatopsyche* was more abundant at Calton Creek and Flat Creek compared to the other study streams and reference conditions.

There were also differences in percent filterers, scrapers, and the scraper/filterer ratio. Percent filterers was much higher and the scraper/filter ratio was much lower than biological criteria data in fall 2019 samples at Flat Creek and Calton Creek and at the North Fork of the White River and Bryant Creek BIOREF stations. Percent scrapers and the scraper/filterer ratio values were much higher at the Bull Creek BIOREF station and Little Finley Creek in fall 2019. Percent filterer values were highest at the North Fork of the White River BIOREF station, Calton Creek, and Flat Creek in spring 2021. The scraper/filterer ratio was much lower at most stations compared to biological criteria data. Spring 2021 scraper/filterer ratios were lowest at the BIOREF North Fork of the White River and Calton Creek, and ratios at BIOREF Bull Creek, Finley Creek, and Little Finley Creek were much higher than reference conditions. Percent scrapers and scraper/filterer ratio are expected to decline, and filterers are expected to increase as pollution or disturbance increases (Barbour et al. 1999).

6.5 Physicochemical Water Parameters

Water samples collected from the Finley Creek AES-Type study streams and the BIOREF streams met Missouri's WQS with one exception. The fall 2019 duplicate samples collected during the morning hours (0750 hours) at the James River were slightly below the 5 mg/L dissolved oxygen WQS. Although most WQS were met, turbidity, nitrate+nitrite-N, total

nitrogen, and total phosphorus were commonly higher than EPA's recommended nutrient criteria (USEPA 2000). Total nitrogen values were generally much higher in streams in the western part of the EDU than those in the central and eastern portions. Most MSCI scores in the western part of the EDU were fully supporting during both sampling seasons; however, the Crane Creek and Flat Creek macroinvertebrate communities were relatively tolerant during both sampling seasons, and Dry Crane Creek had a more tolerant macroinvertebrate community in fall 2019. Taxa richness and EPTT values were much lower at Calton Creek in fall 2019 compared to the remaining stations sampled.

Studies of streams in the Midwest calculated the concentrations at which nutrients affect macroinvertebrate communities (Wang et al. 2007, Evans-White et al. 2009). Wang et al. (2007) calculated that total nitrogen and total phosphorus affected TR at 0.86 mg/L and 0.04 mg/L, respectively. Wang et al. (2007) also found that Hilsenhoff BI values were affected by total nitrogen at 0.61 mg/L, and total phosphorus started having effects at 0.09 mg/L. Threshold values for TR from the Evans-White et al. (2009) study was 1.04 mg/L for total nitrogen and 0.05 mg/L for total phosphorus. Even though these threshold values are higher than the U.S. EPA recommended reference values, nitrogen values were still higher at streams located in the western part of the EDU during both sampling seasons and all study streams stations in spring 2021.

Other studies have found that nutrient enrichment can lead to secondary effects on macroinvertebrates, such as excessive algae growth, increases in suspended fine particulate organic matter and sediment retention (Graham 1990), and subsequent declines in interstitial space (Broekhuizen et al. 2001) and food quality (Evans-White et al. 2009). Macroinvertebrate communities downstream of WWTF outfalls have exhibited declines in EPTT (Dyer and Wang 2002), increases in hydropsychid caddisflies (Suckling 1982), increases in the nutrient-tolerant chironomids *Dicrotendipes* and *Cricotopus/Orthocladius* group (Jacobsen 2008), and decreases in percent scrapers and scraper/filterer ratio (Poulton et al. 2015). Many of these trends were observed among streams located in the western part of the EDU, even though Flat Creek was the only WWTF receiving stream (Cassville WWTF) in this study. Hydropsychid caddisflies and filterers were higher, and scrapers and the scraper/filterer ratio were lower at Calton, Crane, and Flat creeks, especially in fall 2019. In spring 2021, *Cricotopus/Orthocladius* group was also higher than reference conditions at the same three streams.

7.0 Conclusions

With the exception of the fall 2019 Calton Creek sample, all MSCI scores indicate that the protection of warm water habitat designated use as listed in the Missouri WQS was being met among selected Finley Creek AES-Type streams in the Ozark/White EDU. Most study streams in the western part of the Finley Creek AES-Type within the Ozark/White EDU had higher nutrient concentrations compared to other study streams and BIOREF streams in the EDU.

Tests of the null hypotheses resulted in the following conclusions.

- 1) The macroinvertebrate assemblage of Finley Creek AES-Type study streams will be similar to the macroinvertebrate community of BIOREF streams in the Ozark/White EDU.

This hypothesis was partially accepted. Except for the fall 2019 Calton Creek sample, this hypothesis was accepted. Calton Creek had a partially supporting MSCI score of 14 in fall 2019, but all other samples had fully supporting MSCI scores during both seasons.

2) Physicochemical water quality from the Finley Creek AES-Type study streams will meet the WQS of Missouri (MoDNR 2018e).

This hypothesis was partially accepted. Except for the fall 2019 James River dissolved oxygen concentration, this hypothesis was accepted. Duplicate samples collected during the early morning hours at James River in fall 2019 were slightly below the dissolved oxygen WQS of 5 mg/L.

3) Stream habitat at sampling stations for the Finley Creek AES-Type study streams will be similar to the BIOREF streams in the Ozark/White EDU.

This hypothesis was accepted. Stream habitat scores among study streams ranged from about 92 to 108 percent of the average stream habitat score calculated for the three BIOREF streams in the Ozark/White EDU.

7.0 References Cited

- Allan, J.D. 2004. Landscapes and riverscapes: the influence of land use on stream ecosystems. *Annual Review of Ecology, Evolution, and Systematics* 35: 257-284.
- Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers—periphyton, benthic macroinvertebrates, and fish. 2nd Edition, EPA 841/B-99/002, USEPA, Washington DC.
- Boyer, E.W., C.L. Goodale, N.A. Jaworski, and R. W. Howarth. 2002. Anthropogenic nitrogen sources and relationships to riverine nitrogen export in the northeastern U.S.A. *Biogeochemistry* 57/58: 137-169.
- Broekhuizen, N., S. Parkyn, and D. Miller. 2001. Fine sediment effects on feeding and growth in the invertebrate grazers *Potamopyrgus antipodarum* (Gastropoda, Hydrobiidae) and *Deleatidium* sp. (Ephemeroptera, Leptophlebiidae). *Hydrobiologia* 457:125-132.
- Burdon, F.J., A.R. McIntosh, and J.S. Harding. 2013. Habitat loss drives threshold response of benthic invertebrate communities to deposited sediment in agricultural streams. *Ecological Applications* 23(5): 1036-1047.
- Burrell, T.K., J.M. O'Brien, S.E. Graham, K.S. Simon, J.S. Harding, and A.R. McIntosh. 2013. Riparian shading mitigates stream eutrophication in agricultural catchments. *Freshwater Science* 33(1): 73-84.

- Dyer, S.D., and X. Wang. 2002. A comparison of stream biological responses to discharges from wastewater treatment plants in high and low population density areas. *Environmental Toxicology and Chemistry* 21:1065-1075.
- Evans-White, M.A., W.K. Dodds, D.G. Huggins, and D.S. Baker. 2009. Thresholds in macroinvertebrate biodiversity and stoichiometry across water-quality gradients in Central Plains (USA) streams. *Journal of the North American Benthological Society* 28: 855-868.
- Graham, A.A. 1990. Siltation of stone-surface periphyton in rivers by clay-sized particles from low concentrations in suspension. *Hydrobiologia* 199:107-115.
- Jacobsen, R.E. 2008. Midge (Diptera: Chironomidae and Ceratopogonidae) community response to canal discharge into Everglades National Park, Florida. *Proceedings of the 16th International Chironomid Symposium* 13:39-50.
- Kleekamp 2016. Development of reference reaches for Missouri streams (G13-NPS-08). A final report to the Missouri Department of Natural Resources. Missouri Cooperative Fish and Wildlife Unit, Columbia, Missouri. 196 pp.
- Lenat, D.R. 1984. Agriculture and stream water quality: a biological evaluation of erosion control practices. *Environmental Management* 8(4):333-344.
- Lenat, D.R., and J.K Crawford. 1994. Effects of land use on water quality and aquatic biota of three North Carolina Piedmont streams. *Hydrobiologia* 294:185-199.
- Meador, M.R., and R.M. Goldstein. Assessing water quality at large geographic scales: relations among land use, water physiochemistry, riparian condition, and fish community structure. *Environmental Management* 31(4):504-517.
- Missouri Department of Natural Resources. 2002. Biological Criteria for Wadeable/Perennial Streams of Missouri. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 32 pp.
- Missouri Department of Natural Resources. 2016. Standard Operating Procedure MDNR-ESP-213: Quality Control Procedures for Checking Water Quality Instruments. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 17 pp.
- Missouri Department of Natural Resources. 2018a. Standard Operating Procedure MDNR-ESP-012: Analysis of Turbidity Using the Hach 2100p Portable Turbidimeter. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 13 pp.

Missouri Department of Natural Resources. 2018b. Standard Operating Procedure MDNR-ESP-100: Field Analysis of Water Samples for pH. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 8 pp.

Missouri Department of Natural Resources. 2018c. Standard Operating Procedure MDNR-ESP-101: Field Measurement of Water Temperature. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 4 pp.

Missouri Department of Natural Resources. 2018d. Standard Operating Procedure MDNR-ESP-102: Field Analysis for Specific Conductance. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 9 pp.

Missouri Department of Natural Resources. 2018e. Title 10. Rules of Department of Natural Resources Division 20-Clean Water Commission, Chapter 7-Water Quality. 10 CSR 20-7.031 Water Quality Standards. 131 pp.

Missouri Department of Natural Resources. 2019a. Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 29 pp.

Missouri Department of Natural Resources. 2019b. Standard Operating Procedure MDNR-ESP-103: Sample Collection and Field Analysis for Dissolved Oxygen Using a YSI Membrane Electrode Meter, Hach HQ40d LDO probe or YSI Pro ODO probe. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 11 pp.

Missouri Department of Natural Resources. 2019c. Standard Operating Procedure MDNR-ESP-210. Quality Assurance/Quality Control for Environmental Data Collection. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 13 pp.

Missouri Department of Natural Resources. 2019d. Standard Operating Procedure MDNR-ESP-214: Quality Control Procedures for Data Processing. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 7 pp.

Missouri Department of Natural Resources. 2019e. Stream Habitat Assessment Project Procedure. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 40 pp.

Missouri Department of Natural Resources. 2020a. Quality Assurance Project Plan for Biological Assessment, LDPR Code FEBIO, FETSW, & FECLC. State Fiscal Year 2021.

Prepared by the Missouri Department of Natural Resources, Division of Environmental Quality, Water Protection Program, P.O. Box 176, Jefferson City, Missouri 65102. 24 pp.

Missouri Department of Natural Resources. 2020b. Standard Operating Procedure MDNR-ESP-001. Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 29 pp.

Missouri Department of Natural Resources. 2020c. Standard Operating Procedure MDNR-ESP-113: Flow Measurements in Open Channels. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 16 pp.

Missouri Department of Natural Resources. 2021a. Standard Operating Procedure MDNR-ESP-002: Field Sheet and Chain-of-Custody Record. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 15 pp.

Missouri Department of Natural Resources. 2021b. Standard Operating Procedure MDNR-ESP-209: Taxonomic Levels for Macroinvertebrate Identifications, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 39 pp.

Poulton, B.C., J.L. Graham, T.J. Rasmussen, and M.L. Stone. 2015. Responses of macroinvertebrate community metrics to a wastewater discharge in the Upper Blue River of Kansas and Missouri, USA. *Journal of Water Resource and Protection* 7:1195-1220.

Rabeni, C.F., N. Wang, and R.J. Sarver. 1999. Evaluating adequacy of the representative stream reach used in invertebrate monitoring programs. *Journal of the North American Benthological Society* 18: 284-291

Sowa, S.P., D.D. Diamond, R.A. Abbitt, G.M. Annis, T. Gordon, M.E. Morey, G.R. Sorensen, and D. True. 2004. Final Report of the Aquatic Component of GAP Analysis: A Missouri Prototype. Missouri Resource Assessment Partnership (MoRAP), University of Missouri. 111 pp.

Sowa, S., and D. Diamond. 2006. Using GIS and an Aquatic Ecological Classification System to Classify and Map Distinct Riverine Ecosystems throughout EPA Region 7. Missouri Resource Assessment Partnership (MoRAP), University of Missouri. 242 pp.

Sponseller R.A., E.F. Benfield, H.M. Valett. 2001. Relationships between land use, spatial scale and stream macroinvertebrate communities. *Freshwater Biology* 46: 1409-1424.

Suckling, D.M. 1982. Organic wastewater effects on benthic invertebrates in the Manawatu River. *New Zealand Journal of Marine and Freshwater Research* 16:263-270.

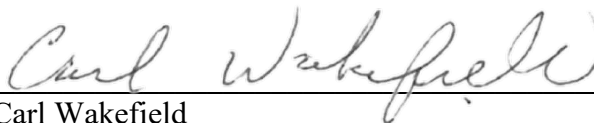
United States Environmental Protection Agency. 2000. Ambient Water Quality Criteria Recommendations. Information Supporting the Development of State and Tribal Nutrient Criteria for River and Streams in Nutrient Ecoregion IX. United States Environmental Protection Agency, Office of Water, Washington, D.C., EPA-822-B-00-019. 28 pp.

United States Geological Survey. 2019. National land cover database: 2019 land cover Available at <https://www.mrlc.gov/data>.

Waite I.R. and P.C. Van Metre. 2017. Multistressor predictive models of invertebrate condition in the Corn Belt, USA. *Freshwater Science* 36(4): 901-914.

Wang, L, D.M. Robertson, and P.J. Garrison. 2007. Linkages between nutrients and assemblages of macroinvertebrates and fish in wadeable streams: implication to nutrient criteria development. *Environmental Management* 39:194-212.

Submitted by:



Carl Wakefield
Environmental Specialist
Water Quality Monitoring Section
Environmental Services Program

Date:

Approved by:



Scott Robinett
Manager, Water Quality Monitoring Section
Environmental Services Program

SR:cwh

c: Robert Voss, QAPP Project Manager, WPP
Tanya Turner, Southwest Regional Office

Appendix A

Macroinvertebrate Bench Sheets for the Finley Creek AES-Type Study

Invertebrate Bench Sheet Report
Fall 2019

Station: Bryant Creek 2535/23.27			
Sample Number 19050			
Date September 19, 2019			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	4		50
AMPHIPODA			
Hyaella azteca			49
BASOMMATOPHORA			
Ancylidae	1	4	2
COLEOPTERA			
Ancyronyx variegatus			1
Berosus			1
Dubiraphia		16	51
Ectopria nervosa	1	11	
Helichus lithophilus			9
Heterosternuta			1
Macronychus glabratus			4
Microcylloepus pusillus			2
Optioservus sandersoni	80	13	4
Psephenus herricki	4	3	
Scirtidae			3
Stenelmis	18	20	
DECAPODA			
Faxonius neglectus	2		1
Faxonius punctimanus			*
DIPTERA			
Ablabesmyia		10	7
Anopheles			1
Cardiocladius	1		
Ceratopogoninae		2	2
Chironomus		5	
Cladotanytarsus	1	2	1
Cricotopus bicinctus	1		
Cricotopus/Orthocladius	2		12
Cryptochironomus	3	7	2
Cryptotendipes		17	1

Station: Bryant Creek 2535/23.27			
Sample Number 19050			
Dicrotendipes		14	1
Dixella			1
Empididae (undescribed)		1	
Forcipomyiinae			1
Hemerodromia	1		
Labrundinia			1
Limnophila	1		
Micropsectra	1		
Microtendipes	3	3	
Nanocladius		1	
Nilothauma			1
Parakiefferiella			1
Paralauterborniella		4	2
Paratanytarsus			3
Phaenopsectra		2	
Polypedilum fallax grp			1
Polypedilum flavum	16	2	
Polypedilum halterale grp		1	
Polypedilum illinoense grp			6
Polypedilum scalaenum grp		7	
Rheotanytarsus	16	1	
Simulium	4		
Stempellina		2	
Stempellinella		9	5
Synorthocladius	1		
Tabanus	2		
Tanytarsus	3	7	11
Thienemanniella	1		
Thienemannimyia grp	1		3
EPHEMEROPTERA			
Acentrella	4		
Anthopotamus	5	38	
Baetis	7		
Baetisca lacustris		1	
Caenis anceps	20	13	
Caenis latipennis		35	6
Centroptilum		2	1
Ephemera simulans	1	5	
Heptageniidae	16	3	

Station: Bryant Creek 2535/23.27 Sample Number 19050			
Isonychia bicolor	68		
Leptophlebiidae		2	3
Leucrocuta	3		
Procloeon	1	3	1
Stenacron	3	2	
Stenonema femoratum		22	
Stenonema mediopunctatum	124	5	
Stenonema pulchellum	25		4
Tricorythodes	43	16	14
HEMIPTERA			
Microvelia			1
MEGALOPTERA			
Corydalus	26		
NEOTAENIOGLOSSA			
Elimia	3	7	
Leptoxis		4	1
Pleurocera		8	*
ODONATA			
Argia		2	3
Basiaeschna janata			*
Calopteryx			4
Enallagma			17
Macromia		*	1
Stylogomphus albistylus			*
PLECOPTERA			
Acroneuria	1		
Chloroperlidae		1	
Leuctra	4		
TRICHOPTERA			
Cheumatopsyche	119		
Chimarra		1	
Helicopsyche	5	1	
Hydropsyche morosa grp	17		
Hydroptila		1	
Nectopsyche		1	
Oecetis		1	12
Polycentropus			7
Protoptila	5		
Triaenodes			10

Station: Bryant Creek 2535/23.27 Sample Number 19050			
TUBIFICIDA			
Limnodrilus hoffmeisteri		2	
Tubificinae	6	2	2
VENEROIDA			
Corbicula		1	

Station: Finley Creek 2352/36.6 Sample Number 19055			
Date: September 18, 2019			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	2	1	2
AMPHIPODA			
Allocrangonyx		1	
Hyaella azteca			105
BASOMMATOPHORA			
Menetus		1	10
COLEOPTERA			
Ancyronyx variegatus			3
Dubiraphia		7	12
Ectopria nervosa	5	2	2
Optioservus sandersoni	1		
Psephenus herricki	188	68	2
Scirtidae			8
Stenelmis	4	40	
Tropisternus			*
DECAPODA			
Faxonius neglectus	*	*	1
Faxonius ozarkae	1		
DIPTERA			
Ablabesmyia	1	5	3
Ceratopogoninae		2	
Chironomidae			2
Chironomus		7	
Cladotanytarsus		1	
Corynoneura		1	
Cricotopus/Orthocladius	5	1	1

Station: Finley Creek 2352/36.6 Sample Number 19055			
Cryptochironomus			1
Cryptotendipes		1	
Dicrotendipes		9	13
Dixella			14
Forcipomyiinae			1
Hexatoma	6	*	
Labrundinia			3
Limnophila		3	
Micropsectra			1
Microtendipes	2	1	
Parametriocnemus			1
Paratanytarsus		1	2
Paratendipes		1	
Phaenopsectra		2	
Polypedilum fallax grp			2
Polypedilum flavum	83	1	1
Polypedilum illinoense grp	3		7
Polypedilum scalaenum grp		2	
Rheotanytarsus	29		
Simulium	16		
Stempellinella		7	1
Stenochironomus			1
Synorthocladius	1	1	1
Tabanus	*	*	
Tanytarsus	2	2	4
Thienemanniella	10	1	1
Thienemannimyia grp	3	1	2
EPHEMEROPTERA			
Baetis	134		
Caenis anceps	2	4	
Caenis latipennis	1	24	25
Centroptilum			1
Choroterpes		19	
Ephemera	1	8	*
Heptageniidae	2		
Isonychia bicolor	29		
Leptophlebiidae			3
Leucrocuta	15	3	
Plauditus	3		

Station: Finley Creek 2352/36.6 Sample Number 19055			
Procloeon		1	
Stenacron		8	
Stenonema bednariki	3		
Stenonema femoratum		31	
Stenonema mediopunctatum	1		
Tricorythodes	4	5	
LUMBRICINA			
Lumbricina	2	*	
LUMBRICULIDA			
Lumbriculidae			2
MEGALOPTERA			
Corydalus	1		
Nigronia serricornis		*	
Sialis		1	
NEOTAENIOGLOSSA			
Elimia	30	12	4
ODONATA			
Argia	2	2	4
Basiaeschna janata			*
Calopteryx			4
Enallagma			30
Gomphidae	3		
Hagenius brevistylus		1	
Macromia			*
Stylogomphus albistylus	2	*	
PLECOPTERA			
Acroneuria	*	1	
Agnetina flavescens	9	1	
Leuctra	2		
Neoperla	19	2	
TRICHOPTERA			
Cheumatopsyche	125		1
Chimarra	44		
Helicopsyche	9		
Hydropsyche morosa grp	4		
Limnephilidae			*
Lype diversa			1
Oecetis		1	13
Polycentropus		1	

Station: Finley Creek 2352/36.6 Sample Number 19055			
Triaenodes			31
TRICLADIDA			
Planariidae	2	1	1
TUBIFICIDA			
Limnodrilus hoffmeisteri		1	
Tubificinae		2	

Station: James River 2365/26.7 Sample Number 19056			
Date September 19, 2019			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	5		1
AMPHIPODA			
Hyaella azteca			44
Stygobromus	1		
BASOMMATOPHORA			
Ancylidae		1	1
Menetus			1
Physella			1
BRANCHIOBELLELLIDA			
Branchiobdellida			1
COLEOPTERA			
Dubiraphia		3	6
Ectopria nervosa		9	5
Helichus lithophilus			2
Microcylloepus pusillus			6
Psephenus herricki	62	84	3
Scirtidae			4
Stenelmis	5	178	
DECAPODA			
Faxonius neglectus	*		*
Faxonius ozarkae	*		
DIPTERA			
Ablabesmyia		8	4
Anopheles			1
Chironomidae	2	2	3

Station: James River 2365/26.7 Sample Number 19056			
Corynoneura			1
Cricotopus/Orthocladius	14	1	3
Cryptochironomus		2	
Dicortendipes		21	
Dixella			3
Ephydriidae	*		
Forcipomyiinae	2		5
Hemerodromia			2
Hexatoma		*	
Labrundinia		2	9
Microtendipes		3	
Nilothauma		1	
Parametriocnemus	10		
Paratendipes		1	
Phaenopsectra		4	
Polypedilum flavum	27		1
Polypedilum illinoense grp		1	7
Polypedilum scalaenum grp		1	1
Rheocricotopus	1		
Rheotanytarsus	49		3
Simulium	4		2
Stempellinella	1	7	
Stenochironomus	1	1	4
Synorthocladius	1	2	
Tabanus	*	*	
Tanytarsus	5	20	23
Thienemanniella	25	4	2
Thienemannimyia grp	10	2	17
EPHEMEROPTERA			
Acerpenna	13	1	1
Anthopotamus		2	
Baetis	57		
Caenis anceps	50	35	4
Caenis latipennis		9	25
Choroterpes		3	
Ephemera	17	11	
Isonychia bicolor	124		4
Leptophlebiidae	2	23	7
Leucrocuta	15		

Station: James River 2365/26.7 Sample Number 19056			
Procloeon		3	
Stenacron	7	25	3
Stenonema bednariki	67		
Stenonema femoratum		34	
Stenonema mediopunctatum	7		1
Stenonema pulchellum	37		4
Stenonema terminatum	10		1
Tricorythodes	2	12	
HEMIPTERA			
Rheumatobates			1
Trepobates			1
LUMBRICINA			
Lumbricina	*	1	
MEGALOPTERA			
Corydalus	6	*	
Sialis		2	
NEOTAENIOGLOSSA			
Elimia	4	1	17
ODONATA			
Argia	8	40	2
Basiaeschna janata			2
Boyeria			1
Calopteryx			1
Enallagma			8
Gomphidae			3
Hagenius brevistylus			1
Stylogomphus albistylus		5	1
PHARYNGOBDELLIDA			
Hirudinidae			*
PLECOPTERA			
Acro-neuria	*	*	
Leuctra	1		
Neoperla	28	12	
TRICHOPTERA			
Cheumatopsyche	69		7
Chimarra	5		
Helicopsyche	4		
Hydroptila			1
Nectopsyche		1	

Station: James River 2365/26.7 Sample Number 19056			
Oecetis			7
Polycentropus		1	
Triaenodes			38
TRICLADIDA			
Planariidae	4	4	2
TUBIFICIDA			
Branchiura sowerbyi		4	1
Enchytraeidae		1	
Tubificinae			4

Station: James River 2365/26.7 Sample Number 19057			
Date September 19, 2019			
* - large rare			
ORDER: Observed Taxa	CS	NF	RM
"HYDRACARINA"			
Acarina	1		
AMPHIPODA			
Hyaella azteca			62
ARHYNCHOBDELLIDA			
Erpobdellidae	1		
BASOMMATOPHORA			
Ancylidae			1
Menetus			3
COLEOPTERA			
Dubiraphia			4
Ectopria nervosa	2	3	
Helichus lithophilus			7
Psephenus herricki	59	50	4
Scirtidae			10
Stenelmis	11	61	7
DECAPODA			
Faxonius neglectus	*		
DIPTERA			
Ablabesmyia		2	2
Anopheles			3
Cricotopus bicinctus			1
Cricotopus/Orthocladius	4		1

Station: James River 2365/26.7 Sample Number 19057			
Dicrotendipes		4	5
Dixella			8
Forcipomyiinae	2	2	
Hemerodromia			1
Hexatoma	*	*	
Labrundinia			2
Parametriocnemus	3		
Paratanytarsus			1
Paratendipes			2
Phaenopsectra		6	
Polypedilum flavum	11	1	1
Polypedilum illinoense grp	1		18
Rheotanytarsus	21	1	7
Simulium			5
Stempellinella		2	
Stenochironomus			1
Tabanus	3		
Tanytarsus	3	9	9
Thienemanniella	11	5	3
Thienemannimyia grp	10		20
EPHEMEROPTERA			
Acerpenna	15		3
Anthopotamus		1	
Baetis	24	2	8
Caenis anceps	45	7	3
Caenis latipennis		8	14
Ephemera	13	4	1
Heptageniidae	6		
Isonychia bicolor	60		1
Leptophlebiidae	4	6	8
Leucrocota	11	1	
Procloeon		3	
Stenacron	11	16	2
Stenonema bednariki	41	5	
Stenonema femoratum		5	
Stenonema mediopunctatum	7		
Stenonema pulchellum	37	2	2
Stenonema terminatum	4	1	2

Station: James River 2365/26.7 Sample Number 19057			
Tricorythodes	2	3	2
HEMIPTERA			
Belostoma			1
Trepobates			2
LUMBRICINA			
Lumbricina	4	2	
LUMBRICULIDA			
Lumbriculidae		3	
MEGALOPTERA			
Corydalus	3	2	
Nigronia serricornis		*	
Sialis		*	
NEOTAENIOGLOSSA			
Elimia	3	5	72
ODONATA			
Argia	10	31	
Basiaeschna janata			1
Calopteryx			4
Enallagma			11
Gomphidae	3	1	
Stylogomphus albistylus	1	*	
PLECOPTERA			
Acroneuria	1	*	
Agnetina flavescens	*		
Leuctra	1		
Neoperla	23	3	
Perlidae	2		
TRICHOPTERA			
Cheumatopsyche	34	2	2
Chimarra	3		
Helicopsyche	6	1	
Nyctiophylax			1
Oecetis			2
Triaenodes			8
TRICLADIDA			
Planariidae	1		
TUBIFICIDA			
Tubificinae			1

Station: North Fork White River 2507/19.7 Sample Number 19058			
Date: September 23, 2019			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	18	2	15
AMPHIPODA			
Gammarus	*		
Hyaella azteca			39
BASOMMATOPHORA			
Ancylidae		6	10
Menetus			3
BRANCHIOBDELLIDA			
Branchiobdellida	2		1
COLEOPTERA			
Ancyronyx variegatus			4
Berosus			1
Dubiraphia		27	50
Ectopria nervosa		6	3
Helichus basalis			9
Helichus lithophilus			1
Macronychus glabratus			7
Optioservus sandersoni	76	1	2
Psephenus herricki	3	4	
Scirtidae			1
Stenelmis	1		1
DECAPODA			
Faxonius neglectus	2	*	*
Faxonius punctimanus			*
DIPTERA			
Ablabesmyia		3	3
Antocha	4		1
Cardiocladius	1		
Ceratopogoninae		1	
Chironomidae			1
Cladopelma		1	
Cladotanytarsus	6	53	4
Cricotopus bicinctus	3		5
Cricotopus/Orthocladius	8	1	7
Cryptochironomus	1	8	

Station: North Fork White River 2507/19.7 Sample Number 19058			
Cryptotendipes		1	
Dicrotendipes		2	1
Dixella			4
Forcipomyiinae			2
Hemerodromia			8
Hexatoma	2		
Labrundinia			5
Micropsectra			1
Microtendipes		2	1
Paracladopelma		7	
Parakiefferiella		1	
Paratanytarsus	5		7
Phaenopsectra		8	
Polypedilum flavum	24	4	1
Polypedilum halterale grp		5	
Polypedilum illinoense grp	1		11
Polypedilum scalaenum grp		9	
Procladius		1	
Pseudochironomus		1	
Rheocricotopus	1		1
Rheotanytarsus	7	1	12
Simulium	7		1
Stempellina		1	
Stempellinella		13	4
Stenochironomus		3	
Stictochironomus		1	
Tanytarsus		15	6
Thienemanniella	4		2
Thienemannimyia grp		3	
Tvetenia bavarica grp	1		
Zavreliomyia (Paramerina)			1
EPHEMEROPTERA			
Acentrella	5		
Anthopotamus	1	3	
Baetis	39		6
Baetisca lacustris		3	
Caenis anceps	9	3	1
Caenis latipennis		41	9
Centropilum			3

Station: North Fork White River 2507/19.7 Sample Number 19058			
Ephemera simulans		1	
Hexagenia limbata		1	
Isonychia bicolor	28		6
Labiobaetis			2
Leptophlebiidae			9
Plautidius	13		1
Procladius		5	
Serratella	3		
Stenacron			1
Stenonema femoratum		5	
Stenonema mediopunctatum	9		
Stenonema pulchellum	5		5
Tricorythodes	49	23	13
HEMIPTERA			
Belostoma			*
LUMBRICINA			
Lumbricina	1		
MEGALOPTERA			
Corydalus	3		
Sialis		1	
NEOTAENIOGLOSSA			
Elimia	37	5	4
Hydrobiidae			1
Leptoxis	11	5	
Pleurocera	11	15	2
ODONATA			
Calopteryx			2
Dromogomphus			1
Enallagma		1	26
Hagenius brevistylus		2	
Hetaerina			2
Macromia		*	*
Stylogomphus albistylus		*	
TRICHOPTERA			
Cheumatopsyche	105		11
Glossosoma	4		
Helicopsyche	10		
Hydropsyche morosa grp	33		3
Hydroptila	1		

Station: North Fork White River 2507/19.7 Sample Number 19058			
Nectopsyche	1	4	
Oecetis		2	6
Polycentropus			1
Protophila	28		
Psychomyia	2		
Triaenodes			5
TRICLADIDA			
Planariidae	1		
TUBIFICIDA			
Aulodrilus			1
Limnodrilus hoffmeisteri		1	
Tubificinae		11	6
VENEROIDA			
Corbicula	*	7	

Station: Little Finley Creek 2356/1.3 Sample Number 19059			
Date September 25, 2019			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina		1	
AMPHIPODA			
Crangonyx	*		
Hyalella azteca			153
BASOMMATOPHORA			
Ancylidae			1
Physella			1
COLEOPTERA			
Dubiraphia			3
Ectopria nervosa	1		
Psephenus herricki	306	85	6
Sciuridae			9
Stenelmis	5	19	2
Tropisternus			*
DECAPODA			
Faxonius neglectus	3	*	3
DIPTERA			

Station: Little Finley Creek 2356/1.3 Sample Number 19059			
Ablabesmyia		11	3
Anopheles			1
Chironomus		4	
Corynoneura		1	3
Cricotopus/Orthocladius		2	10
Cryptochironomus		1	
Dicrotendipes		5	5
Dixella			2
Ephydriidae	1		
Forcipomyiinae	1		
Hexatoma		1	
Labrundinia		1	6
Micropsectra			10
Microtendipes			4
Natarsia			1
Parametriocnemus	1	2	
Paratanytarsus			2
Paratendipes			2
Phaenopsectra		1	2
Polypedilum fallax grp			1
Polypedilum flavum	8		2
Polypedilum illinoense grp			2
Rheotanytarsus	3		4
Simulium	1		
Stempellinella	1	8	2
Sublettea			1
Tabanus	1		
Tanytarsus	8	5	20
Thienemanniella	2	1	4
Thienemannimyia grp	4	5	11
Tipula	3		
Zavreliomyia			1
Zavreliomyia (Paramerina)			1
EPHEMEROPTERA			
Acerpenna	9		
Baetis	31		
Caenis anceps	9	3	2
Caenis latipennis		5	48
Callibaetis		1	2

Station: Little Finley Creek 2356/1.3 Sample Number 19059			
Diphetor	3		1
Eurylophella			1
Fallceon	2		
Isonychia bicolor	5		
Leptophlebiidae	2	40	15
Leucrocuta	18	4	
Procloeon			2
Stenacron	22	17	6
Stenonema femoratum		48	5
Stenonema pulchellum	49		1
Stenonema terminatum			1
Tricorythodes	2	1	
ISOPODA			
Caecidotea (Blind & Unpigmented)			2
Lirceus			1
LUMBRICINA			
Lumbricina		*	
LUMBRICULIDA			
Lumbriculidae			1
MEGALOPTERA			
Corydalus	*		
Nigronia serricornis			1
Sialis		*	
NEOTAENIOGLOSSA			
Elimia	22	1	6
ODONATA			
Argia		4	
Calopteryx			5
Stylogomphus albistylus		1	1
PLECOPTERA			
Acroneuria	6	3	
Agnetina flavescens	10		
Capniidae	1		
Leuctra	10	7	1
TRICHOPTERA			
Cheumatopsyche	70		
Helicopsyche	2	1	
Polycentropus		3	2
Triaenodes			3

Station: Little Finley Creek 2356/1.3 Sample Number 19059			
TRICLADIDA			
Planariidae	42	3	1

Station: Crane Creek 2381/4.0 Sample Number 19060			
Date September 25, 2019			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina		3	1
AMPHIPODA			
Hyaella azteca			135
Stygobromus	2	1	
BASOMMATOPHORA			
Ancylidae	2		
Menetus			4
Physella			1
BRANCHIOBELLELLIDA			
Branchiobdellida			2
COLEOPTERA			
Dubiraphia		1	4
Ectopria nervosa			2
Optioservus sandersoni	50	15	
Psephenus herricki	34	22	
Scirtidae			8
Stenelmis	4	4	
DECAPODA			
Faxonius neglectus	*	*	2
Faxonius ozarkae	*		
DIPTERA			
Ablabesmyia		8	1
Cardiocladius	7		
Ceratopogoninae			1
Cricotopus bicinctus			1
Cricotopus/Orthocladius	2	2	3
Cryptochironomus	1	2	
Dicortendipes		3	1
Dixella			1

Station: Crane Creek 2381/4.0 Sample Number 19060			
Hemerodromia	4	3	4
Labrundinia			4
Limnophila	1		
Microtendipes	4	22	7
Parakiefferiella			1
Paralauterborniella			1
Paratanytarsus		1	6
Polypedilum aviceps	1		
Polypedilum flavum	47	5	
Polypedilum illinoense grp			5
Polypedilum scalaenum grp		1	
Rheotanytarsus	23	9	2
Simulium	2		
Stempellinella	18	30	4
Stenochironomus			1
Sublettea		1	
Synorthocladius		3	
Tabanus		1	
Tanytarsus	2	3	18
Thienemanniella	1	4	
Thienemannimyia grp	4	7	3
Zavrelimyia (Paramerina)			1
EPHEMEROPTERA			
Acentrella	3	1	
Acerpenna	4		
Baetis	51	2	2
Caenis anceps	43	64	
Caenis latipennis	1	19	16
Centroptilum			1
Ephemera simulans	21	22	2
Eurylophella		1	
Isonychia bicolor	48		
Leptophlebiidae		14	1
Leucrocuta	2		
Serratella	2		
Stenacron	27	74	2
Stenonema bednariki	31	3	
Stenonema mediopunctatum	58	15	
Stenonema pulchellum	63	2	

Station: Crane Creek 2381/4.0 Sample Number 19060			
Tricorythodes	2	6	1
HEMIPTERA			
Ranatra fusca			1
ISOPODA			
Caecidotea (Blind & Unpigmented)	2		
Lirceus	25	3	8
LUMBRICINA			
Lumbricina	1	*	
MEGALOPTERA			
Corydalus	4		
Nigronia serricornis	6	*	3
NEOTAENIOGLOSSA			
Elimia	60	23	4
Hydrobiidae			4
Pleurocera			*
ODONATA			
Calopteryx			13
Hagenius brevistylus			1
Ischnura	3	3	6
Macromia			*
Pachydiplax longipennis			*
Stylogomphus albistylus		*	
PLECOPTERA			
Acroneuria	2	3	
Leuctra	3	1	1
Pteronarcys pictetii	*		
RHYNCHOBDELLIDA			
Glossiphoniidae	2	2	
TRICHOPTERA			
Cheumatopsyche	19 3	1	6
Chimarra	5		
Helicopsyche	4	8	1
Hydropsyche morosa grp	9		
Limnephilidae			*
Oecetis		1	
Polycentropus		1	4
Psychomyia	1		
Setodes		1	

Station: Crane Creek 2381/4.0 Sample Number 19060			
Trienodes			13
TRICLADIDA			
Planariidae	1	1	1
TUBIFICIDA			
Aulodrilus			1
Branchiura sowerbyi	1		
Limnodrilus hoffmeisteri		2	1
Tubificinae	8	4	5
VENEROIDA			
Pisidiidae	1	2	1

Station: Calton Creek 2392/2.9 Sample Number 19061			
Date September 25, 2019			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	23		4
AMPHIPODA			
Hyaella azteca		1	8
COLEOPTERA			
Optioservus sandersoni	126	47	6
Psephenus herricki	2	4	
DECAPODA			
Faxonius neglectus	*	*	*
Faxonius ozarkae		1	
DIPTERA			
Ablabesmyia	1	9	
Ceratopogoninae	1	1	1
Clinocera			1
Corynoneura	1		2
Dixa			6
Dixella			2
Hemerodromia	2	2	2
Hexatoma		6	
Micropsectra		1	2
Microtendipes		4	
Myxosargus			6

Station: Calton Creek 2392/2.9 Sample Number 19061			
Natarsia		1	
Parametriocnemus		2	4
Paratendipes		1	
Phaenopsectra		3	
Polypedilum aviceps	8	4	3
Polypedilum flavum	3		
Polypedilum scalaenum grp		1	
Polypedilum tritum	1		
Rheocricotopus			4
Rheotanytarsus	4	1	13
Simulium	1		
Stempellinella	2	24	12
Stenochironomus		2	1
Tabanus		*	
Tanytarsus	5	3	3
Thienemanniella	8	1	2
Thienemannimyia grp	4	3	12
Tipula			9
Tvetenia bavarica grp	2		1
EPHEMEROPTERA			
Acentrella	11		
Acerpenna	2	1	9
Baetis	43		2
Caenis latipennis		2	
Dipheter	50	2	8
Eurylophella	8		1
Heptageniidae	8	1	
Leptophlebiidae	1	51	2
Leucrocuta		10	
Stenacron	3	62	1
Stenonema femoratum		4	
Stenonema pulchellum	12		2
Stenonema terminatum			1
HEMIPTERA			
Belostoma			*
Microvelia			3
ISOPODA			
Lirceus	3	6	
LUMBRICINA			

Station: Calton Creek 2392/2.9 Sample Number 19061			
Lumbricina		7	
LUMBRICULIDA			
Lumbriculidae		3	
MEGALOPTERA			
Nigronia serricornis	2	2	2
NEOTAENIOGLOSSA			
Elimia	20	14	27
ODONATA			
Calopteryx			3
Gomphidae	3	3	
Hagenius brevistylus		1	
Hetaerina			4
Stylogomphus albistylus		6	
PLECOPTERA			
Acroneuria	5	8	1
Leuctra	2	5	
TRICHOPTERA			
Cheumatopsyche	219	15	54
Chimarra	32	2	6
Helicopsyche	8	10	1
Hydropsyche	4	1	6
Hydroptila			1
Limnephilidae			1
Polycentropus	2	2	
TRICLADIDA			
Planariidae	24	9	25
TUBIFICIDA			
Tubificinae		5	2
VENEROIDA			
Pisidiidae	1	1	

Station: Bull Creek 2423/10.1 Sample Number 19062			
Date September 26, 2019			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	13		1

Station: Bull Creek 2423/10.1 Sample Number 19062			
AMPHIPODA			
Hyaella azteca			81
COLEOPTERA			
Ancyronyx variegatus			1
Dubiraphia		1	15
Ectopria nervosa			5
Microcylloepus pusillus			6
Optioservus sandersoni	9		
Psephenus herricki	198	200	14
Scirtidae			1
Stenelmis	18	8	1
DECAPODA			
Faxonius neglectus	1	*	1
Faxonius ozarkae	*	*	*
DIPTERA			
Ablabesmyia	1		
Atherix	*		
Ceratopogoninae	3		
Chironomus		3	
Chrysops			1
Cricotopus/Orthocladius	1		4
Dicrotendipes		1	10
Labrundinia			6
Microtendipes			1
Paralauterborniella	1		
Parametriocnemus	1		1
Phaenopsectra		1	2
Polypedilum aviceps	1		
Polypedilum fallax grp	1		2
Polypedilum flavum	5		3
Polypedilum illinoense grp			6
Procladius		1	
Rheocricotopus	2		
Rheotanytarsus	3	1	2
Simulium	2		
Stempellinella	3	2	1
Stenochironomus			2
Synorthocladius	1		
Tabanus	*	*	

Station: Bull Creek 2423/10.1 Sample Number 19062			
Tanytarsus			2
Thienemanniella	1		
Thienemannimyia grp		3	5
EPHEMEROPTERA			
Acerpenna			1
Baetis	19		1
Caenis anceps	2	4	1
Caenis latipennis			1
Isonychia bicolor	9		
Leptophlebiidae		4	2
Leucrocuta	5	5	
Plautidius		1	
Stenacron		5	1
Stenonema femoratum		20	7
Stenonema mediopunctatum	60	3	
Stenonema pulchellum	28	7	
Stenonema terminatum			1
HEMIPTERA			
Rheumatobates			2
LEPIDOPTERA			
Petrophila			1
LUMBRICINA			
Lumbricina	1	*	1
LUMBRICULIDA			
Lumbriculidae			1
MEGALOPTERA			
Corydalus	4	*	
Sialis		*	
NEOTAENIOGLOSSA			
Elimia	89	6	40
ODONATA			
Argia	3	7	
Calopteryx			1
Enallagma			7
Hetaerina			1
Stylogomphus albistylus	6	1	
PHARYNGOBDELLIDA			
Hirudinidae	*		
PLECOPTERA			

Station: Bull Creek 2423/10.1 Sample Number 19062			
Acroneuria	*	*	
Agnetina flavescens	29		
Leuctra			1
Neoperla		5	
Pteronarcys pictetii	*		
TRICHOPTERA			
Cheumatopsyche	35		
Chimarra	3		
Helicopsyche	16	1	
Hydroptila			1
Lepidostoma	1		
Marilia	10		
Oecetis			1
Polycentropus			5
Trienodes			8
TRICLADIDA			
Planariidae	5	*	
TUBIFICIDA			
Aulodrilus			1
Branchiura sowerbyi		1	

Station: Dry Crane Creek 2381/3.2/0.6 Sample Number 19063			
Date September 26, 2019			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	21	1	
AMPHIPODA			
Crangonyx	3		1
Hyaella azteca			212
Stygobromus	4		
BASOMMATOPHORA			
Ancylidae	2	2	
Menetus	1		
BRANCHIOBELLELLIDA			
Branchiobdellida			1
COLEOPTERA			

Station: Dry Crane Creek 2381/3.2/0.6 Sample Number 19063			
Dubiraphia		1	
Optioservus sandersoni	67	2	1
Psephenus herricki	108	2	
Scirtidae			2
Stenelmis	5	7	
DECAPODA			
Faxonius neglectus	4	*	3
DIPTERA			
Ablabesmyia	1	5	
Anopheles			3
Chironomidae			2
Chironomus		1	
Chrysops			1
Cricotopus bicinctus	1		1
Cricotopus/Orthocladius	5		2
Dicortendipes	1	1	1
Diptera	1		
Dixella			9
Forcipomyiinae	1		
Hemerodromia	4		
Hexatoma		1	
Microtendipes	1	3	1
Myxosargus			2
Neozavrelia	1		
Nilotanytus	3		
Parametriocnemus	5		
Paratanytarsus	3	4	1
Paratendipes		1	1
Polypedilum fallax grp	3		
Polypedilum flavum	1		
Polypedilum illinoense grp	11		8
Rheocricotopus	4		
Rheotanytarsus	16		1
Stempellinella	13	4	1
Stenochironomus			1
Tanytarsus	63	6	3
Thienemanniella	20		3
Thienemannimyia grp	10	2	2
Tipula	57		

Station: Dry Crane Creek 2381/3.2/0.6 Sample Number 19063			
Zavreliomyia		1	
EPHEMEROPTERA			
Acerpenna	2		
Baetis	8	2	
Caenis anceps	5	3	
Caenis latipennis		60	11
Dipheter	4		
Eurylophella	16	1	1
Isonychia bicolor	2		
Leptophlebiidae	27	12	6
Procloeon			2
Stenacron	21	7	
Stenonema femoratum	1	182	6
Stenonema pulchellum	14		
HEMIPTERA			
Belostoma			*
Microvelia			1
Rheumatobates	1		1
Veliidae	1		1
ISOPODA			
Lirceus	4	7	8
LUMBRICINA			
Lumbricina	6	1	
LUMBRICULIDA			
Lumbriculidae	2		
MEGALOPTERA			
Nigronia serricornis	4	*	1
Sialis		*	
NEOTAENIOGLOSSA			
Elimia	2		
ODONATA			
Argia		4	
Calopteryx			8
Enallagma			3
Stylogomphus albistylus	1	*	*
PLECOPTERA			
Acroneuria	2	2	
Agnetina capitata	2		
Leuctra	5	3	1

Station: Dry Crane Creek 2381/3.2/0.6 Sample Number 19063			
TRICHOPTERA			
Cheumatopsyche	33		
Chimarra	7		
Helicopsyche	6		
Polycentropus	15	6	10
Triaenodes			15
TRICLADIDA			
Planariidae	17	1	2
TUBIFICIDA			
Tubificinae			1

Station: Flat Creek 2387/36.2 Sample Numbr 19070			
Date October 10, 2019			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	3	3	1
AMPHIPODA			
Allocrangonyx		1	
Hyaella azteca			36
Stygobromus		1	
BASOMMATOPHORA			
Ancylidae		1	
BRANCHIOBDELLIDA			
Branchiobdellida			1
COLEOPTERA			
Ancyronyx variegatus			1
Dubiraphia			5
Ectopria nervosa		4	1
Optioservus sandersoni	9	2	
Psephenus herricki	15	11	
Stenelmis	3	119	
DECAPODA			
Faxonius neglectus	*		1
DIPTERA			
Ablabesmyia		6	1
Cardiocladius	1		

Station: Flat Creek 2387/36.2 Sample Numbr 19070			
Clinocera	1		
Cricotopus bicinctus			1
Cricotopus/Orthocladius		1	4
Dicortendipes		1	7
Hemerodromia	2		3
Labrundinia		1	2
Microtendipes		9	1
Parametriocnemus	3		
Paratanytarsus		1	
Phaenopsectra		2	1
Polypedilum flavum	13		1
Polypedilum illinoense grp			2
Rheocricotopus	2		
Rheotanytarsus	15		9
Simulium	3		
Stempellinella	6	28	9
Stenochironomus	1		6
Synorthocladius	4	8	1
Tabanus	*	*	
Tanytarsus		10	14
Thienemanniella	3	2	
Thienemannimyia grp	3	14	5
EPHEMEROPTERA			
Acentrella	5		
Acerpenna		2	1
Anthopotamus		2	
Baetis	84		
Caenis anceps	1		
Caenis latipennis		21	15
Choroterpes		1	
Ephemera	1	1	
Eurylophella		1	
Heptageniidae	11	1	
Isonychia bicolor	68		
Leptophlebiidae		26	1
Procloeon		2	2
Stenacron	2	8	
Stenonema bednariki	15	1	
Stenonema femoratum		34	1

Station: Flat Creek 2387/36.2 Sample Numbr 19070			
Stenonema mediopunctatum	83		
Stenonema pulchellum	9		1
Teloganopsis deficiens	5		
Tricorythodes		1	
ISOPODA			
Caecidotea (Blind & Unpigmented)		1	
Lirceus	20	8	15
LUMBRICINA			
Lumbricina	*		
MEGALOPTERA			
Corydalus	13		
NEOTAENIOGLOSSA			
Elimia	5	12	1
Pleurocera		*	
ODONATA			
Argia		7	8
Calopteryx			3
Enallagma			10
Gomphidae	8	7	
Hagenius brevistylus		*	
Hetaerina			4
Macromia			*
PLECOPTERA			
Agnetina flavescens	16	2	
TRICHOPTERA			
Cheumatopsyche	363		1
Chimarra	10		
Helicopsyche	7	3	1
Hydropsyche morosa grp	30		
Lype diversa			1
Marilia		2	
Nectopsyche			1
Oecetis		1	46
Polycentropus		2	10
Psychomyia	1		
Triaenodes			57
TRICLADIDA			
Planariidae	5	7	

Station: Flat Creek 2387/36.2 Sample Numbr 19070			
TUBIFICIDA			
Tubificinae			1

Invertebrate Bench Sheet Report
Spring 2021

Station: Flat Creek 2387/36.2 Sample Number 21061			
Date March 10, 2021			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	8	10	1
AMPHIPODA			
Hyaella azteca			1
BASOMMATOPHORA			
Ancylidae	1		
Physella			*
COLEOPTERA			
Dubiraphia			1
Ectopria nervosa	1	1	1
Optioservus sandersoni	7		
Psephenus herricki	2	8	
Stenelmis	9	17	1
DECAPODA			
Faxonius neglectus		*	1
DIPTERA			
Antocha	1	1	
Ceratopogoninae	2	11	1
Cricotopus/Orthocladius	121	21	24
Cryptochironomus		2	
Dicrotendipes			2
Eukiefferiella	10		20
Hemerodromia	13	3	1
Labrundinia			1
Micropsectra	1	3	
Parametriocnemus	1		
Phaenopsectra		14	
Polypedilum flavum	1		
Polypedilum laetum	1		
Rheocricotopus	1		
Rheotanytarsus			5
Simulium	6		3
Stempellinella	5	11	1

Station: Flat Creek 2387/36.2 Sample Number 21061			
Stenochironomus		1	1
Sublettea	5		
Sympotthastia	3		4
Synorthocladius		2	
Tabanus	3	*	
Tanytarsus	6	16	6
Thienemanniella			2
Thienemannimyia grp	4	9	10
Tipula		*	
EPHEMEROPTERA			
Acentrella	47		1
Acerpenna	3	2	
Baetis	3		2
Caenis latipennis	1	34	5
Ephemera simulans	4	6	
Ephemerella invaria	5		
Eurylophella bicolor	15	52	24
Isonychia bicolor	13		2
Leptophlebia		6	1
Paraleptophlebia	4	2	
Stenacron	11	15	
Stenonema bednariki	36	2	
Stenonema femoratum		2	
Stenonema mediopunctatum	28	4	2
Stenonema pulchellum	16	3	2
Teloganopsis deficiens	15		1
ISOPODA			
Caecidotea (Blind & Unpigmented)	1		
Lirceus	70	30	40
LUMBRICULIDA			
Lumbriculidae		*	
MEGALOPTERA			
Corydalus	1		
Nigronia serricornis		*	
Sialis		1	
NEOTAENIOGLOSSA			
Elimia	13	2	83
Pleurocera	1		2
ODONATA			

Station: Flat Creek 2387/36.2 Sample Number 21061			
Argia		*	1
Basiaeschna janata			*
Calopteryx			4
Macromia			*
Stylogomphus sigmastylus	3	*	
PLECOPTERA			
Agnetina flavescens	20	1	1
Amphinemura	4		
Isoperla	1		
Leuctridae		1	
Neoperla	3	2	
Perlesta	1		3
Perlinella ephyre		1	
TRICHOPTERA			
Cernotina		1	
Cheumatopsyche	44	2	5
Chimarra	9		
Helicopsyche	51	3	2
Hydropsyche morosa grp	3	1	
Hydropsyche slossonae	1		
Marilia	10	3	
Mystacides		1	
Oecetis	1		16
Polycentropus	1	3	
Psychomyia	6		
Triaenodes			9
TRICLADIDA			
Planariidae	23	5	
TUBIFICIDA			
Limnodrilus hoffmeisteri			1
Tubificinae		1	3

Station: Flat Creek 2387/36.2 Sample Number 21062			
Date March 10, 2021			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			

Station: Flat Creek 2387/36.2 Sample Number 21062			
Acarina	22	5	
AMPHIPODA			
Hyaella azteca			5
BASOMMATOPHORA			
Ancylidae		1	1
Helisoma			*
COLEOPTERA			
Dubiraphia			2
Ectopria nervosa	*	1	
Optioservus sandersoni	1	1	
Psephenus herricki	4	6	
Stenelmis	9	19	
DECAPODA			
Faxonius neglectus	*		2
DIPTERA			
Ablabesmyia	1		1
Cricotopus/Orthocladius	104	25	16
Dicrotendipes		3	1
Eukiefferiella	12		3
Hemerodromia	8	2	1
Hydrobaenus		2	
Labrundinia		3	1
Parametriocnemus	1		
Pericomaina		1	
Phaenopsectra	1	8	
Polypedilum laetum		1	1
Rheotanytarsus		1	2
Simulium	5		1
Stempellinella	5	13	3
Stenochironomus		1	
Stictochironomus		2	
Sublettea	3		
Sympotthastia	1	3	
Synorthocladius		1	1
Tabanus	*	1	
Tanytarsus	14	19	9
Thienemanniella			2
Thienemannimyia grp	4	16	11
Tipula		*	

Station: Flat Creek 2387/36.2 Sample Number 21062			
EPHEMEROPTERA			
Acentrella	36	1	
Anthopotamus	*		
Baetis	3		
Caenis latipennis	7	36	
Dipheter	3		1
Ephemera simulans	*	5	
Ephemerella invaria	4	1	
Eurylophella bicolor	20	52	11
Heptageniidae	28	1	
Isonychia bicolor	15		*
Leptophlebia	*	6	7
Paraleptophlebia		2	
Stenacron	2	10	
Stenonema bednariki	22	6	1
Stenonema femoratum	*	8	
Stenonema mediopunctatum	25	2	
Stenonema pulchellum	7	2	2
Teloganopsis deficiens	15	3	
ISOPODA			
Lirceus	77	36	12
LUMBRICINA			
Lumbricina		*	
MEGALOPTERA			
Corydalus	*		1
NEOTAENIOGLOSSA			
Elimia	4	3	134
Pleurocera			*
ODONATA			
Argia	2	2	
Enallagma			1
Hetaerina			2
Stylogomphus sigmastylus		1	*
PLECOPTERA			
Agnetina flavescens	10		
Amphinemura	3		
Leuctridae	1	1	
Neoperla	1	5	1
Perlesta	3		

Station: Flat Creek 2387/36.2 Sample Number 21062			
TRICHOPTERA			
Cheumatopsyche	41	1	1
Chimarra	5	1	
Helicopsyche	23	3	
Hydropsyche morosa grp	4		
Ironoquia			1
Lepidostoma		1	
Marilia	8	2	
Oecetis			10
Plectrocnemia			3
Psychomyia	3	1	
Pycnopsyche			*
Triaenodes			5
TRICLADIDA			
Planariidae	31	13	1
TUBIFICIDA			
Tubificinae			2
VENEROIDA			
Corbicula		1	

Station: Crane Creek 2381/4.0 Sample Number 21063			
Date March 10, 2021			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	3	4	4
AMPHIPODA			
Hyaella azteca			28
Stygobromus		4	
ARHYNCHOBDELLIDA			
Erpobdellidae		*	
BASOMMATOPHORA			
Menetus		2	
COLEOPTERA			
Dubiraphia		1	*
Ectopria nervosa			1
Optioservus sandersoni	54	12	2

Station: Crane Creek 2381/4.0 Sample Number 21063			
Psephenus herricki	3	1	
Scirtidae			1
Stenelmis	4	3	
DECAPODA			
Faxonius neglectus	*	1	*
DIPTERA			
Ablabesmyia	1	1	2
Ceratopogoninae		4	
Cladotanytarsus	3		
Clinocera	2	1	
Cricotopus/Orthocladius	77	51	116
Cryptochironomus	5	7	
Dicrotendipes	3		4
Eukiefferiella	10	30	4
Eukiefferiella devonica grp			1
Hemerodromia		1	6
Hexatoma		*	
Hydrobaenus	1	1	1
Labrundinia			2
Micropsectra	2	2	2
Microtendipes		1	
Paratanytarsus	2		13
Phaenopsectra	5		
Polypedilum flavum		1	2
Polypedilum laetum		1	
Polypedilum scalaenum grp		1	
Rheotanytarsus	1	1	5
Stempellinella	25	4	8
Stictochironomus	2		
Sympotthastia			1
Synorthocladius	4		1
Tabanus	*		
Tanytarsus	24	5	14
Thienemanniella	1	3	
Thienemannimyia grp	3	9	4
Tipula	*		
Tribelos	2		
EPHEMEROPTERA			
Acentrella	2		

Station: Crane Creek 2381/4.0 Sample Number 21063			
Baetis	3		2
Caenis latipennis	4	41	10
Ephemera simulans	9	2	*
Ephemerella invaria	20	15	6
Eurylophella bicolor	1	52	10
Eurylophella enoensis		2	5
Heptageniidae	10	2	1
Isonychia bicolor	29	*	1
Leptophlebia	3	4	4
Leucrocota	6	1	
Neocloeon			3
Stenacron	14	12	1
Stenonema bednariki	6		
Stenonema mediopunctatum	32	6	
Stenonema pulchellum	42	1	
Stenonema terminatum	8	1	
Teloganopsis deficiens	9		3
ISOPODA			
Lirceus	152	4	9
LEPIDOPTERA			
Petrophila	1		
LUMBRICINA			
Lumbricina	*	1	
MEGALOPTERA			
Corydalus	1		
Nigronia serricornis	3	1	*
Sialis	*	*	
NEOTAENIOGLOSSA			
Elimia	21	8	2
Pleurocera			1
ODONATA			
Argia			1
Calopteryx			2
Gomphidae	1		
Hagenius brevistylus			1
PLECOPTERA			
Acroneuria	3		
Leuctridae	4	5	
Pteronarcys pictetii		1	

Station: Crane Creek 2381/4.0 Sample Number 21063			
TRICHOPTERA			
Cheumatopsyche	15		1
Chimarra	7		1
Helicopsyche	16	3	
Hydropsyche morosa grp	1		
Hydroptila		1	
Lepidostoma			1
Mystacides		1	
Oecetis			2
Plectrocnemia	2	1	2
Psychomyia	5	1	
Triaenodes			9
TRICLADIDA			
Planariidae	8		
TUBIFICIDA			
Enchytraeidae	5		
Limnodrilus hoffmeisteri	6	2	
Tubificinae	18	3	1
VENEROIDA			
Corbicula	*	1	

Station: James River 2365/26.7 Sampler Number 21073			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina		1	1
AMPHIPODA			
Crangonyx			1
Hyaella azteca			13
Stygobromus	1	1	
ARHYNCHOBELLELLIDA			
Erpobdellidae		1	
BASOMMATOPHORA			
Menetus	1		
Physella	1		
COLEOPTERA			
Ectopria nervosa		1	

Station: James River 2365/26.7 Sampler Number 21073			
Paracymus		1	
Psephenus herricki	26	17	2
Scirtidae		1	
Stenelmis	11	72	4
DECAPODA			
Faxonius	1		
Faxonius neglectus		1	7
DIPTERA			
Ablabesmyia		2	
Chironomidae	2	1	3
Clinocera	10	5	
Cricotopus/Orthocladius	16	5	17
Cryptochironomus		1	
Diamesa	1		
Dicrotendipes			2
Empididae (undescribed)		1	
Eukiefferiella	21		9
Hemerodromia	3		2
Hexatoma	21	26	
Hybomitra		1	
Hydrobaenus		1	
Microtendipes	1	1	
Natarsia		1	
Parachaetocladius	1		
Parametriocnemus	44	5	1
Paratanytarsus			1
Paratendipes		2	
Phaenopsectra		3	1
Polypedilum flavum	1		1
Polypedilum illinoense grp			1
Polypedilum scalaenum grp		2	
Prosimulium	1		
Rheotanytarsus			3
Simulium	1		
Stempellinella		1	
Sympotthastia	17	2	8
Tabanus	1		
Tanytarsus	3	5	1
Thienemannimyia grp	4	11	9

Station: James River 2365/26.7 Sampler Number 21073			
Tipula	*		*
Zavrelimyia		1	
EPHEMEROPTERA			
Acentrella	2		2
Acerpenna	19		24
Anthopotamus		1	
Caenis anceps		3	
Caenis latipennis	24	60	46
Dipheter	4		
Ephemera simulans	1	9	
Ephemerella invaria	2		
Eurylophella bicolor	2	4	12
Eurylophella enoensis			2
Heptageniidae	13		
Isonychia bicolor	28		1
Leptophlebia	9	2	5
Leucrocota	46	13	2
Paraleptophlebia		4	7
Plautidius			2
Stenacron	4	10	
Stenonema bednariki	7	1	
Stenonema femoratum	4	11	1
Stenonema mediopunctatum	6		
Stenonema pulchellum	33	1	3
Stenonema terminatum	8		
ISOPODA			
Caecidotea (Blind & Unpigmented)	1	4	
LUMBRICINA			
Lumbricina	29	4	1
LUMBRICULIDA			
Lumbriculidae		4	
MEGALOPTERA			
Corydalus	2		
NEOTAENIOGLOSSA			
Elimia	14	2	4
Hydrobiidae		1	
ODONATA			
Argia	*	2	
Basiaeschna janata			1

Station: James River 2365/26.7 Sampler Number 21073			
Enallagma			2
Stylogomphus sigmastylus	2	*	*
PLECOPTERA			
Acroneuria	4		
Agnetina flavescens	6		
Alloperla	29	14	
Amphinemura	110		45
Isoperla	49	2	4
Neoperla	27	6	
Perlesta	8	1	32
Zealeuctra	2	3	
TRICHOPTERA			
Agapetus	3		
Cheumatopsyche	13		3
Helicopsyche	4	1	3
Ochrotrichia	2		
Oecetis			1
Plectrocnemia	1		
Rhyacophila	8		
Triaenodes			1
TRICLADIDA			
Planariidae	13	3	1
TUBIFICIDA			
Branchiura sowerbyi		3	
Limnodrilus hoffmeisteri		5	
Tubificinae		4	
VENEROIDA			
Pisidiidae	1		

Station: Finley Creek 2352/36.6 Sample Number 21074			
Date March 24, 2021			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	1	4	1
AMPHIPODA			
Crangonyx	2		

Station: Finley Creek 2352/36.6 Sample Number 21074			
Gammarus		3	3
Hyaella azteca			1
ARHYNCHOBDELLIDA			
Erpobdellidae			*
BASOMMATOPHORA			
Ancylidae		1	
Menetus		1	
BRANCHIOBDELLIDA			
Branchiobdellida	1		
COLEOPTERA			
Dubiraphia		1	
Ectopria nervosa	1		
Helichus basalis			1
Ochthebius	2		
Optioservus sandersoni	2		
Paracymus	1		
Peltodytes			1
Psephenus herricki	5	20	*
Stenelmis	5	9	
DECAPODA			
Faxonius neglectus	1		5
DIPTERA			
Ablabesmyia		1	
Ceratopogoninae	1	6	
Cladotanytarsus		1	
Clinocera	14	4	
Corynoneura		1	2
Cricotopus/Orthocladius	10	3	22
Cryptochironomus		1	
Dicrotendipes			1
Erioptera	1		
Eukiefferiella	21	1	7
Hemerodromia		2	
Hexatoma	9	10	
Micropsectra	2		
Microtendipes		1	
Muscidae		1	
Parametriocnemus	7	1	1
Paratanytarsus		1	2

Station: Finley Creek 2352/36.6 Sample Number 21074			
Polypedilum aviceps	1		
Polypedilum flavum	5		
Polypedilum illinoense grp			1
Prosimulium	1		
Rheotanytarsus			3
Stempellinella	3		
Sympotthastia	90	12	50
Tabanus	1	1	
Tanytarsus		4	1
Thienemanniella			1
Thienemannimyia grp	8	6	14
Zavrelimyia		1	1
EPHEMEROPTERA			
Acentrella	41		
Acerpenna	2		3
Anthopotamus		5	
Caenis anceps	1	4	
Caenis latipennis	14	51	25
Dipheter	2		1
Ephemera simulans	1	4	
Ephemerella invaria	1		
Eurylophella bicolor	2	1	1
Isonychia bicolor	1		2
Leptophlebia	5	3	11
Leucrocota	89	3	
Paraleptophlebia	10	8	8
Plauditus	9		3
Siphonurus			5
Stenacron	5	5	
Stenonema bednariki	2		
Stenonema femoratum	4	21	2
Stenonema mediopunctatum	4		
Stenonema pulchellum	5		
Stenonema terminatum	1		
ISOPODA			
Lirceus	3	1	1
LUMBRICINA			
Lumbricina	4	4	
MEGALOPTERA			

Station: Finley Creek 2352/36.6			
Sample Number 21074			
Nigronia serricornis			*
NEOTAENIOGLOSSA			
Elimia	2	4	79
ODONATA			
Calopteryx			1
Enallagma			1
Gomphidae	2		
Stylogomphus sigmastylus	*		*
PLECOPTERA			
Acroneuria		*	
Agnetina flavescens	1		
Alloperla	36	5	
Amphinemura	30		8
Clioperla clio			*
Isoperla	77	1	
Neoperla	8	1	
Perlesta	18	2	11
Perlinella drymo		1	*
Perlinella ephyre	4	2	
Prostoia	3		
Zealeuctra	1	1	
TRICHOPTERA			
Agapetus	1		
Cheumatopsyche	5		1
Chimarra	10		
Ochrotrichia			1
Oecetis			1
Plectrocnemia	5	3	1
Ptilostomis			*
Pycnopsyche			*
Rhyacophila			1
TRICLADIDA			
Planariidae	4	1	
TUBIFICIDA			
Enchytraeidae	1		
Limnodrilus claparedianus		1	
Limnodrilus hoffmeisteri		12	1
Tubificinae		21	

Station: Little Finley Creek 2356/1.3			
Sample Number 21075			
Date March 24, 2021			
* - large rare			
ORDER	CS	NF	RM
AMPHIPODA			
Crangonyx	1		2
Hyaella azteca		*	32
Stygobromus	1		
BASOMMATOPHORA			
Ancylidae			1
Physella			1
COLEOPTERA			
Dubiraphia		1	
Psephenus herricki	14	8	1
Stenelmis	15	1	2
Tropisternus			1
DECAPODA			
Faxonius neglectus	*	3	6
DIPTERA			
Ablabesmyia		1	
Ceratopogoninae		1	
Chaetocladius	1		
Chironomidae	1	1	
Clinocera	11		
Cricotopus/Orthocladius	4		
Cryptochironomus		1	
Dicerotendipes			1
Erioptera			2
Eukiefferiella	2		
Hemerodromia		1	
Hexatoma	5	1	
Micropsectra	2		2
Microtendipes		3	
Parametriocnemus	9		
Polypedilum aviceps	1		
Polypedilum flavum	2		
Polypedilum illinoense grp		2	
Simulium	3		4
Sympotthastia	10		8
Tabanus	*		

Station: Little Finley Creek 2356/1.3 Sample Number 21075			
Tanytarsus	15	5	3
Thienemannimyia grp		8	1
Tipula	*		
Tvetenia bavarica grp			1
Zavrelimyia		2	
EPHEMEROPTERA			
Acentrella	32		8
Acerpenna	8		2
Caenis latipennis	3	47	14
Dipheter	37		9
Eurylophella bicolor	5	28	44
Heptageniidae	13	2	
Isonychia bicolor	2		
Leptophlebia			2
Leucrocuta	158	34	2
Paraleptophlebia	2	33	25
Plauditus			1
Stenacron	6	29	
Stenonema bednariki	1		
Stenonema femoratum	5	29	2
Stenonema pulchellum	30	5	2
HEMIPTERA			
Microvelia			3
ISOPODA			
Caecidotea	1	1	3
Caecidotea (Blind & Unpigmented)		1	
LUMBRICINA			
Lumbricina	1	2	
MEGALOPTERA			
Corydalus	*	*	
Sialis		*	
NEOTAENIOGLOSSA			
Elimia	*	1	82
ODONATA			
Calopteryx			1
PLECOPTERA			
Acroneuria	3	*	
Alloperla	23	8	

Station: Little Finley Creek 2356/1.3 Sample Number 21075			
Amphinemura	55	1	47
Clioperla clio			2
Isoperla	74	2	25
Leuctridae	20	24	4
Neoperla	5		
Perlesta	46	6	11
Prostoia	1		
TRICHOPTERA			
Cheumatopsyche	7	1	5
Chimarra	4		
Helicopsyche	*		
Hydroptila			1
Isonychia			1
Plectrocnemia	1	6	
Polycentropodidae			1
Rhyacophila	*		
TRICLADIDA			
Planariidae	8	3	3
TUBIFICIDA			
Limnodrilus hoffmeisteri		6	
Tubificinae		6	

Station: Dry Crane Creek 2381/3.2/0.6 Sample Number 21077			
Date March 29, 2021			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	4	2	1
AMPHIPODA			
Crangonyx	12	4	
Gammarus	5	2	3
Hyaella azteca			8
Stygobromus	1		
BASOMMATOPHORA			
Menetus	1		
COLEOPTERA			
Agabus	1		

Station: Dry Crane Creek 2381/3.2/0.6 Sample Number 21077			
Dubiraphia		1	1
Ochthebius			1
Optioservus sandersoni	11	3	
Paracymus	1		
Psephenus herricki	9	8	2
Stenelmis	15	3	
DECAPODA			
Faxonius neglectus	1	*	2
DIPTERA			
Ablabesmyia		2	
Brillia			3
Chironomidae	3		2
Chironomus		1	
Clinocera	18	10	
Cricotopus/Orthocladius	35	3	15
Dicrotendipes		1	2
Eukiefferiella	30	1	5
Hemerodromia		3	
Limnophila	1		
Micropsectra	2	1	7
Microtendipes		3	
Neozavrelia	1		
Parametriocnemus	4	2	
Polypedilum aviceps	3		1
Polypedilum illinoense grp			1
Rheocricotopus	7		
Rheotanytarsus	3	1	1
Simulium	1		
Stempellinella		1	
Stictochironomus	1	1	
Synorthocladius	2		
Tanytarsus	40	11	6
Thienemanniella	1		
Thienemannimyia grp	7	32	10
Tipula	2	1	
Zavrelimyia		3	
EPHEMEROPTERA			
Acentrella	15		
Ameletus			1

Station: Dry Crane Creek 2381/3.2/0.6 Sample Number 21077			
Anafroptilum			2
Baetis	1		
Caenis latipennis	2	12	1
Dipheter	5	1	3
Ephemerella invaria	2	20	
Eurylophella bicolor	4		20
Eurylophella enoensis		1	
Isonychia bicolor	1		1
Leptophlebia		3	2
Leucrocuta	42	13	
Neoleptophlebia	12	15	2
Paraleptophlebia	6	6	2
Stenacron		15	
Stenonema bednariki	1		
Stenonema femoratum	7	20	7
Stenonema mediopunctatum		1	
Stenonema pulchellum	7	3	2
Stenonema terminatum		3	4
Stenonema vicarium			1
HEMIPTERA			
Microvelia			2
ISOPODA			
Lirceus	77	18	6
LEPIDOPTERA			
Petrophila	1		
LUMBRICINA			
Lumbricina	*		
MEGALOPTERA			
Nigronia serricornis	1	*	1
NEOTAENIOGLOSSA			
Elimia	14		93
ODONATA			
Argia		1	
Calopteryx			3
Hagenius brevistylus		1	
Stylogomphus sigmastylus	1		1
PLECOPTERA			
Acronuria	5	1	
Alloperla	10	2	

Station: Dry Crane Creek 2381/3.2/0.6 Sample Number 21077			
Amphinemura	54	3	27
Isoperla	12	3	9
Perlesta	5		4
Prostoia			1
Zealeuctra	160	195	6
TRICHOPTERA			
Cheumatopsyche	12		
Chimarra	14	3	
Helicopsyche	1		
Ironoquia			*
Plectrocnemia	9	13	1
Polycentropus			1
Psychomyia	1		
Pycnopsyche			1
Rhyacophila	*		
Triaenodes			3
TRICLADIDA			
Planariidae	8	3	
TUBIFICIDA			
Enchytraeidae		3	
Limnodrilus hoffmeisteri		3	
Tubificinae		18	1

Station: Calton Creek 2392/2.9 Sample Number 21078			
Date March 29, 20121			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	3	11	5
AMPHIPODA			
Crangonyx	4	5	6
ARHYNCHOBDSELLIDA			
Erpobdellidae	*		
BRANCHIOBDSELLIDA			
Branchiobdellida			2
COLEOPTERA			
Optioservus sandersoni	52	8	4

Station: Calton Creek 2392/2.9 Sample Number 21078			
DECAPODA			
Faxonius neglectus		*	*
DIPTERA			
Antocha	2		
Cardiocladius	13		11
Ceratopogonidae		1	1
Chaetocladius			1
Chelifera		1	
Cricotopus bicinctus		1	7
Cricotopus trifascia	16		26
Cricotopus/Orthocladius	92	11	41
Cryptochironomus		1	
Diamesa	2		1
Dicrotendipes		8	
Ephydriidae			1
Eukiefferiella	33	1	19
Hemerodromia	4	2	
Hexatoma	*		
Micropsectra	45	42	19
Neozavrelia			1
Paratanytarsus		1	1
Polypedilum aviceps	11		2
Polypedilum scalaenum grp		6	
Polypedilum tritum		1	
Pseudorthocladius			1
Rheocricotopus			1
Rheotanytarsus	1		1
Simulium	3		4
Stempellina	1	9	1
Stenochironomus			1
Stictochironomus		1	
Sympotthastia			1
Synorthocladius	1	3	2
Tanytarsus	13	25	6
Thienemanniella	1		1
Thienemannimyia grp	14	37	6
Tipula	*	*	*
Tvetenia bavarica grp	1		
EPHEMEROPTERA			

Station: Calton Creek 2392/2.9 Sample Number 21078			
Acentrella	16		2
Anafroptilum		2	5
Baetis	1		1
Dipheter	4		
Eurylophella bicolor	2	42	23
Leptophlebia			1
Leucrocuta	1		
Neoleptophlebia		1	
Paraleptophlebia	4	3	1
Stenacron	6	10	2
Stenonema femoratum		2	1
Stenonema pulchellum	20	1	2
Stenonema vicarium	*		
HEMIPTERA			
Aquarius			*
Belostoma			*
Microvelia			1
ISOPODA			
Caecidotea (Blind & Unpigmented)		2	
Lirceus	31	24	2
LUMBRICINA			
Lumbricina	*	*	
LUMBRICULIDA			
Lumbriculidae		4	
MEGALOPTERA			
Nigronia serricornis	2	*	*
NEOTAENIOGLOSSA			
Elimia	33	6	70
ODONATA			
Calopteryx			4
Stylogomphus sigmastylus			*
PLECOPTERA			
Acroneuria	2		
Amphinemura	3		10
Chloroperlidae	2	1	
Clioperla clio			*
Isoperla	1		*
Perlesta	13	1	4
Zealeuctra	64	65	9

Station: Calton Creek 2392/2.9 Sample Number 21078			
TRICHOPTERA			
Agapetus			1
Cheumatopsyche	73		1
Chimarra	3		
Helicopsyche	9	1	
Hydropsyche	1		
Hydropsyche slossonae	1		
Ochrotrichia	2		2
Oecetis			1
Plectrocnemia	1	8	1
Pycnopsyche			*
TRICLADIDA			
Planariidae	28	3	2
TUBIFICIDA			
Limnodrilus hoffmeisteri		1	1
Tubificinae			5

Station: Bull Creek 2423/10.1 Sample Number 21079			
Date March 30, 2021			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	1	1	1
AMPHIPODA			
Hyaella azteca			2
BASOMMATOPHORA			
Ancylidae		1	
BRANCHIOBELLELLIDA			
Branchiobdellida	1		
COLEOPTERA			
Dubiraphia	2	4	1
Optioservus sandersoni	1	2	
Psephenus herricki	118	36	11
Stenelmis	11	3	1
DECAPODA			
Faxonius longidigitus			*
Faxonius neglectus	1		1

Station: Bull Creek 2423/10.1 Sample Number 21079			
Faxonius ozarkae	1		
Faxonius virilis			*
DIPTERA			
Ablabesmyia		1	
Brillia	1		
Ceratopogoninae		1	1
Chironomidae	1		1
Clinocera	13		1
Constempellina		1	
Corynoneura		2	
Cricotopus/Orthocladius	13		5
Empididae (undescribed)		1	
Eukiefferiella	16		
Hexatoma		*	
Labrundinia			1
Micropsectra	2		1
Parametriocnemus	1	1	
Paratanytarsus		2	
Polypedilum flavum	1		
Polypedilum tritum		1	3
Potthastia	2		
Rheocricotopus	1		
Stempellinella	1		1
Sympotthastia	1		5
Tanytarsus	12	8	6
Thienemannimyia grp	12	27	8
Zavrelimyia			2
EPHEMEROPTERA			
Acentrella	5		
Acerpenna	1		
Ameletus			5
Caenis latipennis	4	15	5
Dipheter			1
Ephemera simulans		1	
Ephemerella invaria	1		
Eurylophella bicolor	13	34	39
Heptageniidae	4	8	
Isonychia bicolor	1		
Leptophlebia		2	8

Station: Bull Creek 2423/10.1 Sample Number 21079			
Leucrocota	97	29	
Neoleptophlebia	1		
Paraleptophlebia		6	12
Plauditus	1		
Stenacron	3	3	
Stenonema bednariki	1		
Stenonema femoratum	3	31	3
Stenonema mediopunctatum	19	2	1
Stenonema pulchellum	20	1	5
Stenonema terminatum	2		
ISOPODA			
Caecidotea (Blind & Unpigmented)		2	
LUMBRICINA			
Lumbricina	1		
MEGALOPTERA			
Corydalus	1		
NEOTAENIOGLOSSA			
Elimia	4	11	114
ODONATA			
Argia	5	2	
Boyeria			1
Calopteryx			2
Enallagma			1
Gomphidae	7		
Hagenius brevistylus	1		
Stylogomphus sigmastylus		*	1
PLECOPTERA			
Acroneuria	10	1	
Agnetina flavescens	4		
Alloperla	4	3	
Amphinemura	18		33
Isoperla	32	6	3
Leuctridae	4	2	
Neoperla	6	3	
Perlesta	16	2	20
Perlinella drymo			*
Perlinella ephyre		2	
Pteronarcys pictetii	3		
TRICHOPTERA			

Station: Bull Creek 2423/10.1			
Sample Number 21079			
Agapetus	1		
Cheumatopsyche	13		
Helicopsyche	6	1	
Hydropsyche morosa grp	1		
Lepidostoma	1	2	3
Marilia		1	
Oecetis			2
Plectrocnemia	5	2	2
Polycentropus	1		
Triaenodes			3
TRICLADIDA			
Planariidae	2	1	
TUBIFICIDA			
Enchytraeidae			1
Limnodrilus hoffmeisteri		2	
Tubificinae		2	2
VENEROIDA			
Pisidiidae	1	1	

Station: North Fork White River			
2507/19.7			
Sample Number 21081			
Date March 30, 2021			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	7	1	5
AMPHIPODA			
Gammarus	2		24
Hyaella azteca			2
BASOMMATOPHORA			
Ancylidae			2
BRANCHIOBELLELLIDA			
Branchiobdellida			1
COLEOPTERA			
Ancyronyx variegatus			1
Dubiraphia	5	16	18
Ectopria nervosa	2		1
Helichus lithophilus		1	1

Station: North Fork White River			
2507/19.7			
Sample Number 21081			
Macronychus glabratus	1	2	1
Optioservus sandersoni	9		2
Psephenus herricki	5	1	
Stenelmis	3	2	
DECAPODA			
Faxonius longidigitus			*
Faxonius neglectus	*	*	*
Faxonius punctimanus			*
DIPTERA			
Ablabesmyia		3	3
Antocha	5		1
Cardiocladius	2		
Ceratopogoninae		3	2
Chironomidae		1	
Cladotanytarsus	13	10	1
Clinocera	5	1	
Cricotopus bicinctus	2		
Cricotopus/Orthocladius	51	12	12
Cryptochironomus		5	1
Dicrotendipes		2	2
Diptera		1	
Empididae	1		
Eukiefferiella	53		
Hemerodromia	21	12	2
Micropsectra	2	1	2
Microtendipes	2		
Monodiamesa		5	
Nanocladius		2	
Nilotanytarsus			4
Ormosia		1	
Paracricotopus	1		
Parametriocnemus	18	4	1
Paratanytarsus		1	17
Paratendipes			1
Polypedilum aviceps			3
Polypedilum flavum	7		
Polypedilum laetum			1
Polypedilum scalaenum grp		2	1
Polypedilum tritum			1

Station: North Fork White River			
2507/19.7			
Sample Number 21081			
Prosimulium	5		
Rheocricotopus			2
Rheotanytarsus	8	4	12
Simulium	11		
Stempellinella		3	5
Stictochironomus		2	1
Sublettea		1	1
Sympotthastia	1	3	
Synorthocladius			1
Tanytarsus	1		12
Thienemanniella			1
Thienemannimyia grp		10	16
Tipula	1	*	*
Tvetenia bavarica grp	1		
EPHEMEROPTERA			
Acentrella	36		
Acerpenna			1
Anafroptilum			5
Anthopotamus		8	
Caenis latipennis	27	95	62
Ephemera simulans		1	
Ephemerella invaria	13		
Ephemerella needhami	1		
Eurylophella bicolor	7	30	19
Eurylophella enoensis	2		10
Eurylophella temporalis			1
Heptageniidae	12		5
Hexagenia			*
Isonychia bicolor	24		5
Plauditus			10
Rhithrogena	16		
Stenacron		1	1
Stenonema	7		
Stenonema femoratum	3	15	1
Stenonema mediopunctatum	40	1	6
Stenonema pulchellum	7	4	5
Stenonema terminatum		*	4
Teloganopsis deficiens	2		3
Tricorythodes	1	1	1

Station: North Fork White River			
2507/19.7			
Sample Number 21081			
ISOPODA			
Lirceus		1	3
LUMBRICINA			
Lumbricina	9		1
LUMBRICULIDA			
Lumbriculidae		1	2
MEGALOPTERA			
Corydalus	1		
NEOTAENIOGLOSSA			
Elimia	2		6
Pleurocera	1		2
ODONATA			
Argia			1
Boyeria			*
Calopteryx			1
Enallagma			2
Gomphidae	4		1
Hagenius brevistylus		2	1
Macromia			*
Ophiogomphus	*		
Stylogomphus sigmastylus	*	2	
PLECOPTERA			
Acroneuria	*		
Amphinemura	18		4
Isoperla	4		
Leuctra			1
Perlesta	30	23	25
Pteronarcys pictetii			*
TRICHOPTERA			
Cernotina			3
Cheumatopsyche	37		7
Chimarra	1		
Glossosoma	2		
Helicopsyche	10		1
Hydropsyche morosa grp	1		
Hydroptila	8	1	1
Mystacides	1		
Nectopsyche			7
Oecetis			5

Station: North Fork White River 2507/19.7 Sample Number 21081			
Polycentropus			1
Protoptila	29		
Psychomyia	2	1	1
Pycnopsyche			*
Setodes	3		
Trienodes		1	
TRICLADIDA			
Planariidae	9		1
TUBIFICIDA			
Limnodrilus hoffmeisteri		3	1
Tubificinae		25	7
VENEROIDA			
Corbicula	1		
Pisidiidae		1	1

Station: Bryant Creek 2535/23.27 Sample Number 21091			
Date April 14, 2021			
* - large rare			
ORDER	CS	NF	RM
"HYDRACARINA"			
Acarina	4	3	8
AMPHIPODA			
Gammarus	1		
Hyalella azteca			9
BASOMMATOPHORA			
Gyraulid		1	
COLEOPTERA			
Ancyronyx variegatus			3
Dubiraphia		19	9
Ectopria nervosa			1
Macronychus glabratus			3
Optioservus sandersoni	77	22	5
Psephenus herricki	4		2
Stenelmis	44	8	10
DECAPODA			
Faxonius neglectus	*	*	*
DIPTERA			

Station: Bryant Creek 2535/23.27 Sample Number 21091			
Ablabesmyia		1	4
Cardiocladius	4		
Ceratopogoninae	2	2	1
Chironomidae	4	2	6
Cladotanytarsus	1	53	3
Clinocera	2	1	
Cricotopus/Orthocladius	56	26	17
Cryptochironomus	1	9	1
Dicrotendipes		6	9
Eukiefferiella	57	1	1
Gonomyia	4		
Hemerodromia	13	2	4
Hexatoma	2	2	
Micropsectra	6	1	2
Nilothauma		1	
Parakiefferiella		9	
Paralauterborniella		2	
Paratanytarsus			3
Paratendipes			1
Phaenopsectra		2	1
Polypedilum fallax grp		3	
Polypedilum flavum	22	10	2
Potthastia	3	1	3
Prosimulium	1		
Protoplasma fitchii	*		
Rheotanytarsus			2
Robackia	1		
Simulium	22		1
Stempellina		1	
Stempellinella		4	
Synorthocladius	1		
Tabanus	1		1
Tanytarsus	2	8	8
Thienemanniella			1
Thienemannimyia grp	1	12	13
EPHEMEROPTERA			
Acentrella	7		
Acerpenna	1		
Anafroptilum		1	2

Station: Bryant Creek 2535/23.27 Sample Number 21091			
Anthopotamus	1	28	1
Baetis	8		
Baetisca lacustris			1
Caenis latipennis	6	68	65
Ephemera simulans		*	1
Ephemerella invaria	23	1	1
Eurylophella bicolor	1	11	10
Isonychia bicolor	21		1
Leucrocuta	1		
Plauditus	30	1	3
Rhithrogena	39	1	
Stenacron	1	1	
Stenonema	4		
Stenonema femoratum		2	4
Stenonema mediopunctatum	37	1	
Stenonema pulchellum	45	4	3
Stenonema terminatum			1
Teloganopsis deficiens	21		7
LUMBRICINA			
Lumbricina	4		
MEGALOPTERA			
Corydalus	5		
Nigronia serricornis			1
NEOTAENIOGLOSSA			
Elimia		2	
Pleurocera			1
ODONATA			
Basiaeschna janata			1
Calopteryx			*
Dromogomphus			*
Enallagma			10
Epitheca (Tetragoneuria)			*
Hagenius brevistylus			*
Macromia			*
PLECOPTERA			
Acronetia	1		
Alloperla	1	1	
Amphinemura	14		24
Isoperla	3		1

Station: Bryant Creek 2535/23.27 Sample Number 21091			
Perlesta	50	2	22
Pteronarcys pictetii	1		1
Zealeuctra	12	2	
TRICHOPTERA			
Cheumatopsyche	14		7
Chimarra	1		
Helicopsyche	2		
Hydropsyche morosa grp	5		
Nectopsyche			1
Oecetis		2	1
Polycentropus			4
Protophila	3	1	
Pycnopsyche			*
Triaenodes			2
TUBIFICIDA			
Branchiura sowerbyi		1	
Tubificinae		3	3